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ERRATA.

Page 299, line 9. *For* "Myrmaridæ" *read* "Mymaridæ."

,, 300, line 19 from bottom. *For* "penultimate" *read* "antepenultimate."

I. THE RACES OF INDIAN RATS.

AN ENQUIRY SUPPLEMENTARY TO THE INVESTIGATION OF PLAGUE, AND DEALING WITH THE ORIGIN OF RACES FROM SPORTS.

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PREFATORY NOTE.

The collection on which Captain Lloyd's researches are based consists almost entirely of specimens sent to the Museum by medical and sanitary officers in India and Burma as a result of an appeal circulated by the Government of India in 1907. The history of this appeal is as follows:—At the time that Dr. W. C. Hossack was engaged on the work embodied in his account of the rats of Calcutta, considerable discussion arose as to the species of rats which lived in association with man in different parts of the country. As the matter was an interesting one from every point of view, I wrote to the Board of Scientific Advice, asking the Board to bring to the notice of Government the importance of conducting a concerted survey of the rats of India. The Board forwarded my recommendations, with the result that the circular to which Captain Lloyd refers at the beginning of his paper was issued. Dr Hossack, however, found himself unable to continue his work on rats owing to the stress of other duties, and the Trustees of the Indian Museum failed in their attempt to secure the services of an expert mammalologist from Europe to deal with the collection of which the specimens presented to the Museum by Dr. Hossack formed the nucleus. The Trustees then approached the medical authorities with the suggestion that Captain Lloyd should be put on special duty in the Museum for this purpose. The medical authorities agreed, and Captain Lloyd's term of special duty, at first six months, was later extended to a year and then to eighteen months.

I venture to think that the Trustees' failure to secure the services of a specialist from Europe was not altogether a misfortune, although I was responsible for the suggestion in the first instance. Few zoologists would deny that an expert mammalologist with 2,000 rats before him, and only a year in which to work them out, would have been justified in devoting the whole of that time to a study of taxonomic minutiæ. A resident naturalist was,

however, in a different position. He was acquainted with local conditions and therefore able to start inquiring about doubtful points without the preliminary study necessary to a new-comer whose time in the country was limited. Perhaps, therefore, he was able to view the whole matter from a somewhat more biological point of view.

From a purely taxonomic point of view there are doubtless many zoologists who will find Captain Lloyd's work unsatisfactory, because he does not describe (or at any rate does not name) new species and varieties. It is perhaps as well, however, that animals so important as rats should not be regarded solely from either a taxonomic or a sanitary point of view, but that pure biology should have a place in their study.

Quite apart from the value of Captain Lloyd's researches, the importance of the collection of Indian rats that has now been got together in the Indian Museum must not be forgotten, and I desire, on behalf of the Trustees, to thank those who have assisted in this useful work. I have also to acknowledge a grant of Rs. 300, towards the cost of the plates which illustrate Captain Lloyd's paper, from the Home Department of the Government of India.

N. ANNANDALE,
Superintendent, Indian Museum, Natural History Section.

CALCUTTA:
January 18th, 1909.

INTRODUCTION.

In July, 1907, the Government of India issued a circular to the local Medical and Sanitary Departments in India and Burma, inviting them to co-operate with the Indian Museum in studying the varieties and habits of the common rats distributed throughout those countries. Such an enquiry is much needed at the present day in view of the part played by these rodents in the dissemination of plague. The circular met with considerable response, so that within the following year over two thousand rats were received by the Museum from different places.

Rat-destruction has been carried out on a large scale in many towns throughout the country, and it is chiefly from these centres that rats have been received. Most of them were obtained from districts in which plague has been of annual occurrence, but a number were received from places which have been free from the disease since the commencement of the present epidemic. Material has therefore been acquired by which we can compare plague-ridden districts with plague-free districts, as to the nature of their rat population. It is apparent that the freedom from plague enjoyed by certain districts might possibly be due to some visible peculiarity in the rat population of those districts; there

is some evidence that this is so in the case of Madras city. The distribution of the several species of common rats varies considerably throughout India; especially is this true of the principal sea-port towns. Dr. W. C. Hossack's investigation has shown that the rats of Calcutta city are surprisingly different from the rats of Bombay, which have been described in the reports of the Plague Commission. It will be shown that the rats of Rangoon and Madras cities are also different both from one another and from those of Calcutta and Bombay.

PREVIOUS WORK ON INDIAN RATS.

At the outset it must be pointed out that these results have followed directly on Dr. Hossack's investigation of the rats of Calcutta [1], and are in direct continuation of that work, to the author of which every acknowledgment is due, not only for the guidance afforded by the work itself but also for the results of his experience conveyed in a personal manner.

In an 'historical' paragraph Dr. Hossack reviews the previous writings on the subject of Oriental rats, and although it is unnecessary to repeat that statement here, it may be again mentioned that Mr. Thomas's paper [2], published in 1881, is the foundation on which any subsequent work on the subject must be built. The account of the rats in the *Fauna of British India* seems to have originated from this source.

As these observations are in continuation of Dr. Hossack's work, it does not seem necessary to again define the common Indian species of rats; it will be sufficient to say that they support the opinion that *Mus rattus*, the common rat of India, is, in colour and quality of fur, a most variable species, and that its variations are so numerous and seem to occur in such perfect gradation, when large numbers of specimens are examined, that definite varieties can rarely be established. It will be shown, however, that even in its range of variability *Mus rattus* is not constant throughout India. In some places there is a tendency for rats of this species to breed true to some particular type, while in others they exhibit a range of colour-variation as wide as that of the species in Calcutta (Hossack [1, pages 17 and 18]).

To name new varieties of the species seems unwise, for there is nothing to show that the rats which breed true to some particular type in a given district at the present day were in the same state fifty years ago, or will be found in a like condition fifty years hence. It must be remembered that one hundred generations of rats pass within the lifetime of one man. Moreover the following objection to the naming of varieties may be framed:—To establish a variety and lay down one specimen as its "type" is to acknowledge tacitly that all animals subsequently found from far and near which closely resemble that type must be genetically related to it. After examining large numbers of animals taken from widely separate localities, doubts arise as

to the validity of such an acknowledgment, and the probability that similar variations may arise in two separate localities appears very great.

In illustration of this the following example may be given:—The mole-rat *Gunomys bengalensis* was found to be common in Rangoon, occurring not only in granaries, warehouses and stables, but frequently in the rooms of dwelling-houses situated in the heart of the city. This rat, usually of a greyish brown tint does not as a rule show much colour-variation. However, within the narrow limits of two adjacent houses, in a certain street in Rangoon, a number of pure black specimens were found. (This occurrence will be described in detail further on.) These may be regarded as a new variety which may or may not persist; but there seems to be no reason why a similar localized race should not appear in any other town in India. Indeed some evidence will be brought forward to show that melanotic mole-rats have arisen in two separate parts of Rangoon city itself, independently of one another.

Further, it can be shown that such peculiarities of colour-variation are by no means confined to the phenomenon of melanism. The following example may be quoted:—A race of white-bellied rats of the *Mus rattus* type was met with in Rangoon. The tails of these rats were uniformly dark greyish brown, being of exactly the same tint above and below. Among some hundreds of these rats which were examined, one was obtained which showed a pure white line along the lower surface of its tail,—in other words, the tail was obviously bicoloured. It appears that great stress is laid on this feature in defining species of rats; while it is admitted that within the limits of one species the lower surface of the body may be dark or pure white, the same admission is never extended to the tail. The following difficulty, therefore, presented itself:—Should this single specimen with the bicoloured tail be regarded as a separate species from the others which, except in the one respect, it so closely resembled? The probability that it was merely a sport from the common type appears too great for this step to be taken with any confidence. If now, it is granted that this particular specimen may have arisen as a sport, there appears to be no reason why, being prepotent, it might not have established a family with bicoloured tails within the limits of a few adjacent houses, as in the case of the melanotic *Gunomys*. Such a family would probably die out in a few months, but on the other hand, the strain might become firmly established as a new species.

These remarks have been made in order to explain the paucity of species and varieties recognised, and to defend the practice observed of not defining new species from single individuals or even from small local groups of individuals, which may show well-marked peculiarities of coloration. The literature of Oriental rats frequently reveals species, defined from three or four individuals caught within the narrow limits of a single house, all of which

agree in showing some slight peculiarity distinguishing them from other species. Whether it is possible to rediscover at a later date species defined in such a manner seems doubtful; and if it seemed possible, the question as to whether the individuals on which the rediscovery was alleged would be genetically related to those on which the species was originally defined, appears even more doubtful.

In the writer's opinion it is not possible to "classify" the Oriental rats in a satisfactory manner on the lines on which classification is being attempted at the present day. Before commencing systematic work in a group, the observer must make himself acquainted with the structural features which have been chosen by previous workers in defining new species. In the case of the *Mus rattus* group the following points are considered of sufficient weight to distinguish species: a difference of 30 mm. in "length"; a difference of 5 mm. in the length of the hind foot; of 3 mm. in ear-length; a difference of 20 in tail percentage; as regards colour, redness, yellowness or blackness are considered of importance; a white ventral surface is of some importance; a bicoloured tail (dark above, white below) is regarded as of the utmost importance. In 1903 Oriental rats were arranged in 96 species.

If, with these points well in mind, the observer examines 500 rats caught in different parts of an eastern town and attempts to classify them, he is confronted with an impossibility. (I do not refer to mole-rats, bandicoots and *Mus decumanus*, which are distinct at a glance.) He finds that variation among the heterogeneous collection is wide enough to embrace all, or nearly all, the points chosen by previous writers on which to define species; but he also finds that ten rats caught in the same house will often resemble one another very closely in colour, size, and proportion, always more closely than ten rats taken haphazard from different parts of the town. The rats of two separate houses will sometimes show differences as great as those chosen to distinguish species, while the rats in each house resemble one another very closely indeed. The following difficulty therefore presents itself. Should any or all of these small groups receive specific names?

The common procedure which leads to the definition of a new species of Oriental rat seems to be as follows:—

A field naturalist sets traps in a rat-frequented house or close to a set of burrows in a field; two or three house or field rats are caught; in either case the specimens which closely resemble one another come into the hands of a specialist in Europe, who examines them regarding such features as those enumerated above. Although they resemble one another very closely, it is highly improbable that they will, in every way, closely resemble any previously described species. They are defined as a new species. The discovery of new species on these lines is slow because the number of rats examined is quite insignificant when compared with the number of rats present in one Oriental town. Though slow, the process cannot end.

The definition of such species, however burdensome it may seem, is not in itself fallacious, for a family group of inbred rats taken from a single house or set of burrows may show definite and measurable peculiarities. By naming these groups specifically one does not directly establish a fallacy. Indirectly, however, the procedure causes false impressions, in the following way. When a new species is discovered in a district, the discovery being based on a few specimens caught together, the idea is originated that many other rats in that district will resemble the type of the new species. This is far from being the case. The species of Himalayan rats illustrate this anomaly. From previous writings the impression is given that *Mus jerdoni* is a common rat in Darjiling; that *Mus niveiventer* is common in Katmandu; that *Mus vicerex* [3] is the rat found at Simla. We have received rats from six different parts of Darjiling, none of which resemble *M. jerdoni* in any way; over fifty rats are from Simla, none of which show the peculiarities of *M. vicerex.* Rats brought this year from Katmandu have no resemblance to *M. niveiventer* which was described in 1836 from five rats caught in the Residency of that place. On the other hand, certain rats from Kashmir are very like the type of *M. vicerex,* judging from the description of it. Certain rats from Naini Tal are equally like *M. niveiventer,* though one of these was caught in the same cupboard on the same night with a rat which showed features peculiar to *M. berdmorei* [4], a species only known from Manipur (Assam), and Mergui (Tenasserim). It seems impossible to reconcile results obtained by studying large numbers of rats with results which have been previously obtained by the study of small numbers of specimens.

Great confusion exists in the nomenclature of Oriental rats. The common mole-rat of India was first regarded as a species of *Mus*; later on it was known as *Nesokia bengalensis*; quite recently it has become a species of a new genus *Gunomys* [5]. The antelope rats may be placed in the genera *Meriones*, *Tatera* or *Gerbillus.* Specific names which have been long abolished are often revived. As a result of this it is often difficult to determine the scientific names of common rats.

The following instance may be quoted in illustration of this difficulty. The honorary curator of a local museum sent certain field rats to the Indian Museum for identification. They were returned as *Nesokia hardwickei* and *Gerbillus erythura.* The sender, being desirous of obtaining the best possible results for his museum, sent similar specimens to Europe; they were returned as *Nesokia huttoni* and *Meriones erythrura.* The Indian Museum was informed of this by the curator of the local museum. It cannot, however, be maintained that one pair of names was right and the other wrong. The names given by the Indian Museum for these well-known rats were taken from the *Fauna of British India*, the author of which upholds the name *Gerbillus,* and considers that the specific name *huttoni* is included in *hardwickei.*

Confusion of nomenclature among the group is increasing at the present day. Two new species, *Mus listoni* and *Mus comberi*, have been recently added to the list of Indian rats [6]. In the words of their discoverer "There is little to distinguish *listoni* from *mettada* except the difference in the size of the molars, but this difference is quite constant and easily appreciable even by the naked eye." It seems to be noteworthy that specific differences in an animal so large as a rat should be appreciable even by the naked eye. *Mus comberi* was discovered among eight rats collected at Nasik, four of which were identified as *Mus mettada*, the remaining four being regarded as of the new species. The measurement of the molar series of these specimens is given in millimetres as 5·6, 5·7, 5·7, 5·7; 6, 6, 6·1, 6·2. Those with molar series measuring 5·6—5·7 formed the new species *Mus comberi*. Those from 6—6·2 were regarded as *Mus mettada*. As regards these dimensions, the difference between the largest and smallest in *mettada* is ·2 mm. The difference between the smallest in *mettada* and the largest in *comberi* is ·3 mm. There is *no other difference* between the two species, which live together in Nasik. Anyone who accepts the separation of these two species must suppose that among any thousand "Mettads" from the Nasik district, a very small proportion will possess molar series measuring 5·8 and 5·9 mm.; he must further suppose that a "Mettad" with molar series measuring 5·7 mm. will recognise and refuse to mate with one whose series measures 6 mm., lest mongrel offspring with series of 5·8 and 5·9 be born. After reflecting on the smallness of the dimension represented by ·1 mm., and the impossibility of measuring it by means of ordinary appliances, it is difficult to regard these two suppositions as well founded.

Mus listoni was defined from five specimens from the Konkan; it is separated from *mettada* for the same reason that *Mus comberi* was separated, because the teeth are some three-tenths of a millimetre less than in *mettada*.

Mus listoni and *comberi* are separated because the latter is "distinctly smaller" and for no other reason. The author of these new species gives the dimensions as follows:—

Head and body length in millimetres.

Mus comberi (4 adult females)	118	119	120	125
Mus mettada (3 ,, ,,)	122	122	127	..
Mus listoni (2 ,, ,,)	132	134	..	..

The same author continues: "The specific separation of *comberi* and *listoni*, however, must depend on the non-existence of intermediates (*i.e.*, in size); from my knowledge of the country I argue that the discovery of such is most unlikely, and I have not hesitated, therefore, to rank them both as species."

On examining the measurements we see that the difference between the largest and the smallest *comberi* is 7 mm., and that the difference between the smallest *listoni* and the largest *comberi* is also 7 mm. Why, then, is it necessary to seek further for "intermediates"? In one case a difference of 7 mm. in length between two individual rats is not considered sufficient to separate them as species, while in the case of another pair of rats a precisely similar difference is the sole reason given for separating them.

Introductory statements must be made regarding the way in which the subject has been dealt with in this paper.

HOUSE RATS (*Mus rattus*).

It will be found that the house rats from each place, if received in large numbers, have been sorted into groups according to their lengths, the numbers in each group being represented graphically by an upright line of proportionate length. This method has been much used by biologists of recent years. It is generally applied to large numbers of accurate measurements. In the present instance it will be seen that the numbers that have been so arranged are often not large, nor can the measurements be very accurate. The measurements here recorded are of the distance between the centre of the anus and the tip of the nose in freshly killed rats. If a careful observer measures and records this length in ten freshly killed rats, and, without referring to the first record, repeats the measurement two or more times, he will find that his records do not agree, if the bodies of the rats are disturbed in any way (as by being lifted and replaced on the table) between each set of measurements. The differences observed may be as wide as five millimetres. The error is principally due to the varying attitude of the head and neck. In taking the measurement the head must be straightened, but not stretched from the neck. In his efforts to perform this the recorder arrives at a different result each time. Hence we are dealing with a dimension which cannot be accurately measured. This error contravenes in measuring the limp bodies of rats immediately after their death. If a rat is measured two or three hours after death when the neck is shortened and the spine curved by *rigor mortis*, it may have lost as much as 10 % of its original length. In this case the recorder, while measuring a large rat, is in doubt as to whether 10 mm. or 20 mm. should be added by stretching out the body.

However, as the measurements of different observers must be marred by these accidents by an equal degree, it is clear that a comparison of them must be of value.

Although the sets of measurements were made by different observers working quite independently, they show a striking resemblance to one another. They show that the adult house rats of most districts vary in length from less than 145 mm. to more than 215 mm., but that those of 175—185 mm. are the most numerous. As the same result is obtained from such widely separated districts

as Amritsar, Allahabad, Nowgong, Tellicherri and Calcutta, we must conclude that they form one class throughout, although great individual differences of colour, size and proportion can be noticed among the rats of any one place, and in spite of the fact that the rats of one place may collectively show certain peculiarities of colour and sometimes of proportions. Until recently it was thought that two varieties of the species were to be met with on the plains of India, a large northern variety (*alexandrinus*), measuring abont six inches in length, and a smaller southern variety (*rufescens*). It seems that this idea should now be abandoned.

Reference must be made to the skulls of the rats of this group. It has been mentioned before that over ninety species of rats have been described from the Oriental region which are, indisputably, closely allied to *Mus rattus*. From the definitions of most of these species one learns that each of them has its own peculiar type of skull, the nasals are of a particular length or shape, the auditory bullæ are exceptionally small or unusually inflated, the infraorbital foramen is more open below, the zygomatic plate may form a prominent angle or it may not, the frontoparietal suture is in some a widely open angle, in others it is less obtuse. However small they may be, the skull of each species has its own peculiarities.

But it seems to the writer that in most cases these differences are such as can be readily found among any thousand skulls of rats taken from any town in India. Some of these specific types of skulls have been carefully figured. A comparison of these figures with skulls selected from among large numbers of rats of any district, confirms this opinion. There is, however, a considerable range of variation. Small adult rats as well as young rats differ considerably from large adults in the proportions of their skulls. It will be shown that local groups of rats taken from a single house may have skulls which are very closely alike, all agreeing in that they are distant from the mean of the race to an approximately equal extent.

The differences between the skull types of most of the species of Oriental rats fall within the range of variation exhibited by a small number of rats from one town. This is proved by measurements already published.

For the sake of brevity the writer has dealt only with measurements of the four most important features which are usually recorded in "types" of the species of *Mus*. These features are the greatest or zygomatic breadth of the skull, the length of the nasal bones, and the lengths of the palatine foramen and upper molar series. The measurements have been expressed as percentages of the greatest length of the skull. These features have been chosen because it is in them that the more distinct forms, *Mus mettada*, *Mus decumanus*, *Gunomys*, *Nesokia* and *Bandicota*, differ from one another and from the type of *Mus rattus*.

A standard for comparison is afforded by Hossack's measurements of forty-five skulls of Calcutta house rats of all sizes and of the *Mus rattus* type.

Measurements of forty-five skulls of Mus rattus *from Calcutta.*

		Length.	Breadth.	Nasals.	Pal. for.	Molars.
Maximum..	..	100	52·5	41·09	21·2	19
Minimum ..	..	,,	46·9	32·5	16·2	15·1
Range	..	..	5·6	8·59	5	3·9

Measurements of skulls of "types" or co-types of various species of Indian Rats (W. L. Sclater).

Species		Length.	Breadth.	Nasals.	Pal. for.	Molars.
M. rufescens	..	100	52	38	18	18
M. fulvescens	..	,,	53	43	17	19
M. blanfordi	..	,,	..	42	22	20
M. nitidus	..	,,	51	38	18	18
M. bowersi	..	,,	..	40	17	17
M. berdmorei	..	,,	53	40	19	21
Range	..	..	2	5	5	4

These figures show that the "types" of six distinct species together show a smaller range of variation than forty-five chance-taken rats from one town. Sclater's records are, as a whole, higher than Hossack's. This must be because in measuring the total length of the skulls the former did not include the incisor teeth; consequently the percentage values of the other features were slightly raised.

In the skulls from Calcutta the palatine foramen is sometimes greater, sometimes less, than the molar series. *Mus mettada, Mus decumanus*, and perhaps *Mus jerdoni* have their own skull types and so are excluded.

Species of rats from other parts of the Oriental region do not usually show wider variation in the proportion of their skulls than those presented by Hossack's measurements.

The measurements of three species from the Malay region will be given; they have not been specially selected but are of the three new species of *Mus* recently discovered in that region.

Measurements of skulls of "types" of Malay species (Bonhote).

Species.	Length.	Breadth.	Nasals.	Pal. for.	Molars.
M. bukit	100	48	40	16	17
M. jalorensis ..	,,	47	35	17	17
M. griseiventer ..	,,	45	35	16	16
Range ..	..	3	5	1	1

As regards these measurements, therefore, the three Malay species also fall within the range of variation exhibited by the rats of Calcutta.

A number of species have recently been described from the Andamans. Measurements of the "types" of these show a similar range of variation, if examined in the same way.

Measurements of skulls of "types" of species from the Andamans (G. S. Miller).

Species.	Length.	Breadth.	Nasals.	Pal. for.	Molars.
M. flebilis ..	100	44	40	19	16
M. pulliventer ..	,,	49	36	18	18
M. burrus ..	,,	46	37	18	16
M. burrulus ..	,,	49	36	..	17
M. burrescens ..	,,	49	36	..	17
Range ..	..	5	4	1	2

With the exception of the breadth in *M. flebilis* and *burrus* these measurements are all within the range of variation exhibited by the forty-five Calcutta rats.

The new species *M. stoicus* and *taciturnus* from the Andamans, are short-tailed rats of large size, not of the *rattus* type, and have therefore been excluded.

As regards these important measurements the "types" of all these species scarcely exhibit a wider range of variation than that shown by forty-five *Mus rattus* taken from a single town. It is not likely that the smaller details such as the shape of the nasal bones, zygomatic plates, tympanic bullæ, and the like, will be of value as distinguishing marks of races. The skulls of fifty rats taken from

different parts of any town show very great variation in these minor points; at the same time it must be admitted that a few rats caught in a single house, will often show striking similarity to one another as regards these details.

THE MOLE-RATS.

When the mole-rats and bandicoots of India were first examined by naturalists, the different groups among them received such names as *Mus kok*, *Arvicola bengalensis*, *Nesokia indica*, *Mus plurimammis*, *Mus giganteus*, *Mus bandicota*. In 1878 J. Anderson [10] united them as a sub-genus of *Mus* under the name *Mus* (*Nesokia*), and pointed out the indisputable fact that the group could be subdivided into three series. In 1907 O. Thomas [5] applied a separate generic name to each of these three series, *viz.*—

Nesokia for mole-rats which have a short palatine foramen, a tail which is only about 50 % of the head and body length, and few mammæ.

Gunomys for mole-rats which have a long palatine foramen, a tail which is about 80 % of the head and body length, and a continuous row of teats from the axilla to the inguinal region.

Bandicota for the very large, coarse-furred rats known as "bandicoots," which have a relatively longer skull than the others, a tail nearly equal to the head and body length, and relatively large feet.

Anyone who examines large numbers of these rats must recognise the marked discontinuity between the three groups, and the only objection that can be brought against their receiving generic rank is, that there is no greater difference between them than there is between other groups of small rodents which receive merely specific rank. For example, the difference between a *Gunomys* and a *Nesokia* seems even less, it is certainly not greater, than the difference between *Mus rattus* and *Mus mettada*. In spite of this objection the triple generic nomenclature is used here.

Gunomys (*Nesokia bengalensis*) has been received from the Punjab, Calcutta, Rangoon, Madras, Simla, Nepal and other places.

Nesokia (*Nesokia hardwickei*) only from Quetta and the Punjab.

Bandicota from Madras, Bengal and Nepal.

Although a large number of specimens from any one place always show considerable variation among themselves, there are noticeable differences between the races from several of the places. As these differences seem to be approximately equivalent to those which separate the races of mankind inhabiting the same regions, they have not been considered of sufficient weight to justify the application of specific names. Current literature shows that to honour local races with specific names is becoming a

custom at the present day, when the species of twenty years ago rank as genera, and new species must be found.

Within the last few months a revision of the genera *Gunomys*, *Nesokia* and *Bandicota* has been published [11], including several new species. As the specific characters are founded on the measurements of chance-taken "types," it is impossible to identify our specimens by means of this classification. The difficulty of attempting to do so may be briefly expressed. In this new classification nine species of *Gunomys* are recognised. They are divided into two series, A with upper molars less in length than 7·5 mm., B with upper molars greater than 7·5 mm.

The length of the upper molars in twenty mature specimens of *Gunomys* from Calcutta—presumably *G. bengalensis*—vary from 6·5 to 8 mm. (Hossack). The measurements of the molar series in the types of the nine species of *Gunomys* are, according to this new classification, as follows: Series A, 6·6, 6·8, 7·2, 7·6, 7·8; Series B, 8, 8, 8·3, 8·3. We see therefore that as regards the length of the molars, which is so important a character that it is used in the grouping of the species, twenty chance-taken specimens from Calcutta include no less than seven out of the nine Oriental species of the genus. The skulls from which Hossack's measurements were taken are preserved in the Indian Museum; the accuracy of the measurements cannot be questioned.

On the average the *Gunomys* of the Punjab certainly have larger teeth than the *Gunomys* of Bengal, but the measurements given in the new classification are of chance-taken "types," and variation among the rats of any district is so wide that none of the characters quoted can be relied upon for identification. The only reliable datum is the name of the district from which the "types" were obtained. We know from this that our specimens from Kashmir and Nepal are *G. wardi* and *tarayensis*, respectively. If this method is permissible identification is easy, but the number of species must be large.

It is unfortunate that the author of this classification did not consult Hossack's work; if he had done so he would have avoided the error of supposing that the *Gunomys* of Bengal measures 205 mm. in length. Hossack's measurements of fifty specimens from Calcutta show that the length of this species varies from 160 to 205 mm., with a mean of 182. Specimens measuring over 200 mm can be found only with difficulty.

MEASUREMENTS AND DEFINITIONS.

Before passing to the descriptive portion certain terms must be defined—

1. By the length of a rat is meant the combined length of its head and body, *i.e.*, the distance between the snout and anus; the difficulty of measuring it accurately has been already mentioned. For the sake of brevity measurements have been recorded without

explanation, but always in this particular order: Length, tail length, length of hind foot (from heel to longest toe, excluding the claw), length of ear (the greatest length). In this way the measurement of a common rat would be shown as 175, 200, 30, 20.

2. By the length of a skull is meant the distance from the condyles to that part of the premaxillæ which projects between the incisor teeth. The molar series has been measured at the roots of the teeth where they spring from the sockets. In measuring skulls, ·5 mm. has been usually regarded as the indivisible unit. This seems rather a coarse method, but it was found, when the unit was ·25 mm., that measurements of the same skull, taken by two careful observers, did not often agree. Some workers split the millimetre into ten equal parts; they accomplish this feat presumably by using ordinarily well made dividing compasses, the points of which together rarely measure less than ·3 mm. They are recommended to repeat the measurements of one skull day after day, and to observe the variety of the results obtained.

3. The term "new character" is used here to denote particular characters which are only present in some few members of a race,—for example, about one in every thousand rats has a white-tipped tail. This was noticed in *Mus rattus*, *Mus concolor*, *Gunomys* and *Bandicota*. The phenomenon of a white-tipped tail is spoken of as a new character. Occasionally this particular character is common. Several *Mus concolor* from one district show it. Other examples of new characters are melanism, albinism, albiventralism and caudal bicoloration. There is an undoubted similarity in the method of occurrence of these characters among rats, hence one term is applied to them. A rat showing a new character is a sport, though some sports show more than one such character. By a white-bellied rat is meant one in which the belly, chest, throat, lower jaw, and the inner side of the limbs is covered with pure white fur; this character is very common among Oriental rats.

4. The term "family group" has been frequently used. It was found that the rats of one house were always more closely alike than an equal number of rats taken from different houses in the same town; this is not surprising, but it was sometimes found that the rats from one house or set of burrows were very closely alike, not only in colour, but in proportion of body and skull, and that they were collectively different from the mean of the mixed race of which they formed a part. Rats showing new characters

such as melanism, etc., commonly occur in family groups. A family group may be defined as a small part of a community the members of which resemble one another very closely, so that the mean of their characters is different from the mean of the characters in the general community. Family groups probably arise owing to prepotency and inbreeding. The term "clan" may be suitably applied to them. A family group is originally a small community; it may, however, become a large one: it is then a race. That a very small community may become a large one, despite inbreeding, was shown by the Australian rabbits.

These statements appear somewhat didactic; they are of course merely brief expressions of the writer's opinion. (See Appendix II.)

5. The word type is used by me in two senses. By the type of a species is meant an imaginary individual which embodies the mean characters of the species. By "type" of a species is meant the arbitrarily chosen type specimen which is laid down for reference in some place, like a standard of measurement.
6. The word species has many different shades of meaning; it must however be used in referring to systematic literature. A number of rats which closely resemble one another and form a discontinuous group has been generally spoken of as a race.

SYSTEMATIC DESCRIPTION ACCORDING TO REGIONS.

THE PUNJAB.

Owing to the energy of Captain G. I. Davys, I.M.S., it has been possible to investigate the rats of the Punjab in a most satisfactory manner. Although strenuously engaged on plague duty, he has contrived to send us over 1,000 rats with careful measurements of each. This large collection has been received in the form of skins, including skulls, tails and feet, preserved in spirit. To each skin is attached a metal plate referring to the measurements, which were taken immediately after death by chloroform. This is a very convenient method of transporting large numbers of rats; on arrival they can, if desired, be set up as dried specimens in the conventional state in which small mammals are usually found in museums. The colour of the fur is not altered by the brief immersion in spirit.

Among house rats, we have received 513 of the *Mus rattus* type from fifty villages in the Amritsar district, 105 rats of the same type from Lyallpur, and 55 white-bellied rats from three specified villages. In addition, we have received records of the

weight of 3,000 rats of this type, and large numbers of skins of field rats of different species.

Pjb. 1, *Mus rattus*—

Of the 513 rats of this type, 100 were carefully examined regarding the following points: Texture of the fur, presence or absence of spines, length of bristles, colour of fur, forms of foot

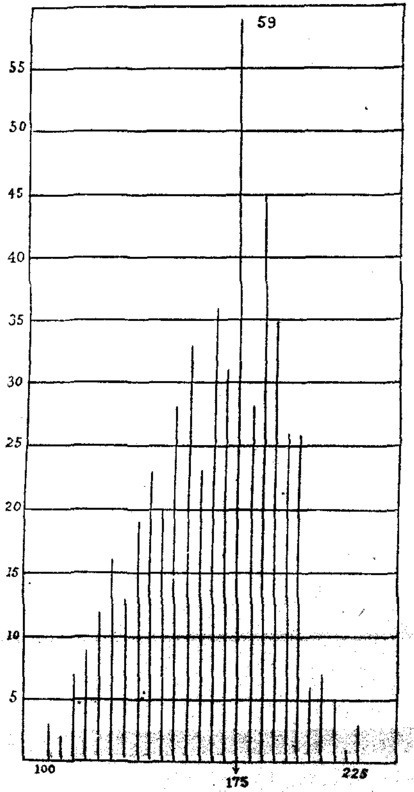

FIG. 1.—Diagram showing the length-frequency of 513 *Mus rattus* from Amritsar (Davys).

pads, number of palatal ridges, number of rings on the toes, length of hair on the tail, and its relation to the length of the scales, difference in colour of the hair above and below the tail, the number of teats, relative proportions of the skull. Where possible, these features were measured, but the measurements will not be recorded here as they show no useful results. Except for the number of palatal ridges, all these points were found to vary within wide or narrow limits. But deviation from the normal in any one character was not regularly associated with deviation in any other character. The group seemed to form one race. That they are one race is shown by the large series of measurements of lengths. The measurements, which were recorded iu millimetres, were arranged in a series of ascending values. The numbers of rats of each length were added together, so that the whole collection became resolved into a series of groups, all the rats of a particular length forming one group. As the collection contained adult rats the lengths of which were as low as 140 mm., and as high as 225, every intermediate value between these extremes being met with, the number of the groups was large. The number was divided by 5, by contraction upon every 5th group. For example, the numbers of rats measuring 153, 154, 156 and 157 mm. were added to the number which measured 155. Those measuring 158, 159, 161 and 162 mm. were added to those measuring 160 mm. The results are shown in a diagram (text-fig. 1) in which the horizontal lines show the lengths in an ascending series, from the left, and the vertical lines indicate the numbers of rats of, or closely approximating to, each length. The diagram shows that rats of about 175 mm. form a majority, that this value is approximately the mean length of the race, and that the numbers of rats of each length become fewer as their lengths become further removed from the mean. It shows, however, that individuals 225 mm. in length can be found and that they are clearly of the same race as those of 180 mm.

It must be pointed out that in constructing the diagram a large number of immature individuals have been included. Their presence accounts for the wider range below the mean than above it, which the diagram exhibits. It is well known that in any character capable of measurement, a group of related organisms shows equal deviation from the mean, both above and below it. We can infer therefore that, since there are at least three individuals of 225 mm. length (*i.e.*, 45 mm. greater than the mean), there must be a small number of mature individuals 135 mm. in length or thereabouts, and that the range in the length of the race is not less than 90 mm. Examination of rats of about 140 mm. length shows that some of them have the 3rd molar worn, and this is usually considered a sign of maturity. No doubt can be thrown on the maturity of a certain small specimen—R. S. No. 674—which measures 140, 155, 28, 14 mm., and weighs 65 gms., the 3rd molar being well worn. The specimen has been sent in spirit complete, so as to show that the uterus contains two embryos in an advanced stage of development.

As the immature have not been excluded, there must be some among those measuring 175 mm. which are not mature; if these had been removed the mean would be raised. Therefore, the mean shown in the diagram is somewhat lower than the true adult mean. The immature were included owing to the difficulty of saying whether many of the smaller individuals were mature or not. It is highly probable that some of the specimens measuring 140 to 150 mm., in which the third molar is cut and even slightly worn, have not stopped growing. Because of this, it was thought best to include the measurements of all specimens received, and this has been done not only in the case of the Punjab rats, but in the case of all house rats from other places when they have been received in sufficient numbers.

These measurements show that the house rats of the Punjab hardly differ in length from the rats of Calcutta. Hossack's measurements of ninety *Mus rattus* afford the only standard available for comparison. The measurements of other writers are of "types." Hossack found pregnant rats of between 140 and 150 mm. length, while among the ninety are six rats of over 190 mm. length; he states and repeats the statement "gradation of size is simply one of age." It is possible that his meaning is not expressed fully; as it stands it is obviously erroneous. A man of six feet four is not always very old; moreover, Hossack's pnblished figures contradict his statement, for while the ninety rats contain only six individuals between 190—200, there are nine between 180—190, and twenty between 170—180. These results are similar to those obtained for *Mus rattus* in other parts of India, and if arranged would show a similar diagram.

The 500 measurements from the Punjab show that adult rats vary from (about) 140 to 225. This is not evidence that the Punjab race is larger than the Calcutta race, as the measurements were taken in a slightly different way in the two cases; moreover, they are of 500 Punjab rats and 90 Calcutta rats. However, it would not be a matter for surprise if the Punjab rats were somewhat larger. The results of length measurements obtained from such different places as the Punjab and Calcutta are therefore approximately the same. They will be compared with those from other parts of India.

Tail length.—There is some evidence that the mean of the tail length in Punjab rats is less than that of the Calcutta race, also that in the Punjab there are groups of rats in which this value is exceptionally low. At first sight Captain Davys's measurements show surprising differences from those of the Calcutta race. Many are shown as having the tail length less than the length. This is partly due to the fact that the measurements were recorded by Davys from the first ring of the tail, and not from the anus. On repeating some of the measurements, but from the anus to tail tip after brief immersion in spirit, it was found that the new values obtained were all about 7 mm. more than those of Davys's records. The difference of course varied with the size of the rat. In order to equalize the Calcutta

and Punjab measurements, 10 mm. was added to the tail length and subtracted from the length in the latter series; even after this very liberal allowance had been made, the difference between the Punjab and Calcutta race is very apparent. Hossack's measurements show that the mean tail length of the Calcutta race averages 125 % of the length. As mentioned before, the Punjab collection was received in batches of about twenty individuals, each batch being collected on a different date and often from a separate village. After making the allowance of ± 10 mm., the average tail percentages of the groups vary from about 115 to 120. One or two exceptional batches, however, show lower values. Lot D. C. shows the lowest of all.

LOT B. R.			LOT L. T.			LOT D. C.		
Length.	Tail.	Percentage.	Length.	Tail.	Percentage.	Length.	Tail.	Percentage.
184	210	113	160	194	121	186	215	115
165	191	115	176	205	117	172	194	113
175	190	108	170	190	111	174	190	109
193	215	111	170	208	122	175	196	112
160	190	118	182	215	118	184	213	116
175	198	113	162	191	118	169	195	116
177	214	120	172	213	123	177	204	115
171	194	123	170	206	121	177	184	104
			164	205	125	177	184'	104
			165	194	117	164	183	111
						165	175	106
						169	179	106
Average	..	115·1	Average	..	119·3	Average	..	110·6

The measurements were all taken by the same hand, all individuals received in each batch were included except those the length of which was less than 160. Small and young rats were excluded, because the ± allowance of 10 mm. would fall too heavily upon them; and because young rats have proportionately longer tails than adults (Hossack). Among the different batches from the Punjab, the Lot L. T. shows one of the highest average tail percentages; Lot D. C. the lowest. The average percentage of all the 500 was not calculated, as it would not accurately represent the value in the whole race. It must be about 117

The writer considers that the above figures show firstly, that the tail percentage of mixed Punjab rats is lower than the same value in Calcutta rats; secondly, that as regards tail length the Punjab rats are not a thoroughly mixed race. The great difference

in this value shown by Lots L. T. and D. C. can only be explained by supposing that the rats were taken from groups the members of which had collectively different tail lengths.

In the proportions of hind feet and ears the Punjab race does not seem to differ from the Calcutta race.

Colour.—As regards colour the Punjab rats are peculiar in one respect. They are less variable than the rats of many other parts of India. Among many thousands, not one melanotic form was met with. Those that were received by the Museum were in spirit, so that fine differences in colour could not be easily appreciated. A considerable number of them were washed and dried; in these the coloured element of the fur was always of a reddish brown tint. The occurrence of white-bellied forms in the Punjab is of particular interest.

Pjb. 2, the white-bellied race—

The Museum had been receiving rats from the Punjab for some months without obtaining a single example of the white-bellied type. Because of the recent observations on the rats of Calcutta, it was thought to be one of the attributes of the species *Mus rattus* to produce white-bellied forms occasionally, and yet although the rats that were arriving from the Punjab were exactly like many of the Calcutta race, there were no white-bellied ones among them. Consequently Captain Davys was addressed on the subject. He replied that although he had often met with rats having pale coloured under parts, he had never, in the Puujab, seen a pure white-bellied rat like those he had previously noticed in Simla, which were as white below as a *Gerbillus*.

Later on, however, a few white-bellied rats were sent from the Punjab, and finally a considerable number of them. Davys paid special attention to the subject, and found that they could always be obtained from three particular villages out of the sixty-nine over which his operations extended. The other villages only contained the dark-bellied type. The three particular villages are not adjacent, one of them is in the Lahore district. As the question is important from more than one point of view (see pages 85, 92) the list will be quoted as we have received it. The rat-catching measures in the Punjab will doubtless be continued, so that it will be possible to confirm or modify the statement at a later date.

AMRITSAR DISTRICT.

Dhoniyia Kalan	300	Kaonke	300
Mode	1,000	Bhadyiar	200
Atari	400	Mahwa (or Mahawa)	2,000
Ruranwala	600	Bagyiarian	100
Dhande	1,000	Galluwala	200
Ranike	200	Raja Tal	2,000
Rangarh	400	Bhaini	1,000
Neshta	100	Doake	600

Baropal	500
Bakna Kalan	88
Bakna Khurd	187
Her	57
Hoshiarnagar	215
Achinkot	87
Lahori Mal	100
Chicha	123
Mahmudnagar	300
Nahtupura	400
Khera	81
Jahtawal	300
Maluwal	132
Lahedwala	100
Gharinda	45
Nowshera Dhala ..	800
Kasel .. .	300
Dhand	159
Adelewala	227
Manj	83
Miran Kot	435
Nurpur	18
Madali Guru	93
Raja Sausi	235
Sarangdeo	16
Chak Misri Khan ..	280
Pundori Waraich ..	253
Wairka	470
Kamalpur	17
Khaparkheri	412
Sangatpura	21
Isapur	16
Kheron	427
Tarantaran	50
Ibban	124
Chatiwind	117
Mehta	50
Loharka	248
Othian	58
Bhullar	75
Karvial	110
None	78
Kakkar	44
Chabalmannan	107
Deo	205
Makanwind	117

LAHORE DISTRICT.

Kila Jiwan Singh ..	355
Thaipura	238
Bhanuckah	127

JULLUNDUR DISTRICT.

Kartarpur	78
Honian	23

LYALLPUR DISTRICT.

Lyallpur	111
AMRITSAR CITY ..	2,786
	22,590

Some of the high numbers are approximations.

The three villages Addelewala, Nowshera Dhala and Kila Jiwan Singh contained white-bellied rats to the extent of about 10 % of the total number caught. The diagram, text-fig. 2, shows that these white-bellied rats scarcely differ in size from the common type. The

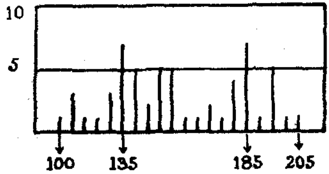

FIG. 2.—Diagram showing the length-frequency of 55 white-bellied *Mus rattus* from the Amritsar district (Davys).

irregularity of the diagram is due to the large number of young ones included. The adult maximum is indicated at 180—185 mm., which seems somewhat high.

The tail proportion was calculated in twenty adults; after making the ±10 mm. correction it is found to vary from 127 % to 102 % with average of 115·3 %. This is low for the Punjab; much lower than the proportion shown by the Calcutta race. The skulls of these white-bellied rats were not found to differ from those of the common Punjab race, which do not seem to differ from the mixed Calcutta race in this respect. These rats are not all of the pure white-bellied type; many of them have a coloured stripe in the middle of the breast; they resemble the Simla race (Sml. 2) in this and all other respects.

Pjb. 3, "*Mus brahminicus*"—

Among the house rats sent by Davys were two of exceptional interest. These resemble one another almost exactly but differ from the common race in more than one respect. They both have a well-marked white star on the forehead, and the terminal third of the tail is pure white. These features are shown in plate i. The sender alluded to them tentatively as a new species "Mus brahminicus" (so called from the "caste mark" on the forehead); and there is no doubt that their peculiarities are better marked than those of many species of the *Mus rattus* group. Since at least twenty-two thousand house rats not showing these peculiarities were captured in the district from which these two were obtained, one cannot regard the pair as part of an established race.

The writer supposes them to be part of a "family group" of sports exactly comparable to the groups Rng. 8 and Ntl. 2. Such groups are too limited in their membership at present to be dignified by the term "race"; however they must each have some slender chance, varying directly with their fitness, of becoming a race.

The measurements of these rats, recorded by the sender, are as follows:—

163	172	31	14	85 grms.
163	167	29	13	95 grms.

they are both of a much lighter colour than the average Punjab rat, their under parts are white, both were certainly adult, the female was pregnant (four embryos). Besides resembling one another closely and differing widely from the average rat in colour, they resemble one another closely in length and weight and differ from the mean length (180 mm.) and mean weight (140 grms.) of the Punjab race.

This pair of sports is biologically of the utmost interest. The most noticeable peculiarity which they exhibit is the absence of pigment from the terminal third of the tail. The change from the pigmented portion to the unpigmented is very sudden, so that one scale possesses its full complement and the next is totally devoid of pigment. The change was so sudden that it called to mind

the human disease leucoderma ; it was, however, felt to be impossible to explain these extraordinary rats as pathological freaks, for the two resemble one another not only in their tails but also in the forehead star, in size, and in the light brown colour of the coat.

Seven species of rats have been recorded from Celebes and the Philippines, in all of which the distal third of the tail is devoid of pigment. They have received the names *Mus xanthurus, celebensis, meyeri, everetti, macleari, luzonicus*; together they form the "*Xanthurus* gronp" [**8**]. There seems, therefore, little doubt that rats showing this peculiarity are an established race in that part of the world. They must be as variable as the rats of India, for when met with they have, more often than not, received a different specific name. If the figure of the tail shown on plate i be compared with the illustration of the tail of *Mus macleari* shown on plate xii, *P.Z.S.*, 1887, no difference can be seen in the appearance of the two appendages. One cannot escape from the conclusion that the character, terminal caudal albinism, which is evidently the mark of a successful race in the neighbourhood of the Philippines, has arisen in the Punjab quite independently on this occasion and probably on many other occasions, in many other places. These sports can not be explained as reversions. Even if one makes the absurd supposition that the *Xanthurus* group represents the parent stock of the Punjab rats, the latter race must be separated from the former by a vast nnmber of generations, for nearly two generations of rats pass in one year.

Pjb. 4, *a Mus rattus with a white-tipped and tufted tail*—

The last centimetre of the tail of this rat and the hair npon it are white. The white hair is usually long and projects 6 mm. beyond the fleshy tip. This case is perhaps of small importance ; similar sports were noticed among the rats of Calcutta ; they are especially common among *Mus concolor.* The same character has been noticed in *Gunomys* and *Bandicota.* This case is mentioned because of the concomitant lengthening of the hair. As the case of Pjb. 3 recalls the *Xanthurus* gronp of the Philippines, so in a lesser degree does this case recall *Mus blanfordi* of the Nilgiri Hills (Madras), the principal feature of which is a tail white in its distal half with lengthening of the terminal hairs.

Pjb. 5, *Gunomys sp.*—

No less than 157 rats of this species have been sent by Davys from fields in the Amritsar district. They resemble one another in having a tail proportion of about 75 %, a hind foot proportion of about 17 %. Their skulls are short and broad, and can be recognised at a glance from those of all other rats. Their skulls, however, resemble those of the newly defined genus *Nesokia*, except that in that genus the incisor teeth are broader and the palatine foramen is concomitantly much shorter than in *Gunomys* (plate iii). The female *Gunomys* has a continuous row of teats on either side,

and produces about ten young at a birth. They form a concrete group sharply defined from all others; in deference to the latest nomenclature they are spoken of as *Gunomys*. They were long known as *Nesokia bengalensis*.

From the collection eighty-five specimens have been selected as undoubted adults, and these alone have been examined in detail. The actual lengths of the specimens are shown on plate v. They vary from 173—235 mm., and form a continuous and almost unbroken series. The line of dots is flatter in the middle and steeper at the ends, individuals of mediocre length being in the majority. Over half the total number are between 192 and 207 mm. in length. The five individuals above 230 mm., which are somewhat separated from the others, are all large males; there is no evidence that they are a separate race because of their size. The percentage of tail length in the length of each individual is shown by the zigzag *At.* which varies from 60—83 with an average of 70 or a little over. The length of their hind feet is shown by the line *Af.*; it is on an average about 16 % of the length.

Comparing these with Hossack's measurements of fifty mole-rats of Calcutta, we see that the Punjab mole-rat is somewhat larger than the Calcutta one. The slight difference in the tail and foot percentages may be explained by the different way in which the measurements were taken in the two cases (see page 18). The difference in length, however, seems too great to be explained in this way.

Fifty Calcutta mole-rats, "Nesokia bengalensis."

	Minimum.	Maximum.	Average of 50.
Length	150	205	182
Tail percentage ..	69	91	81·1
Foot percentage ..	15	19	17·4

In the character of the fur the Punjab race differs considerably from the Calcutta race, so that it would be almost always possible to recognise individual specimens from either place, among a mixed collection. One cannot, however, describe a Punjab type, as there is great variation among the specimens. Two individuals will be described: Specimen T. N. X. 3, a large female measuring 200, 133, 32, 12; specimen K. R. S. 3, a large male measuring 210, 158, 34, 10.

Up to a certain point one description will suffice for both. The colour of the two animals is alike, and in general terms may be described as dark greyish brown above, passing gradually into light grey below. The hairs which compose the dorsal fur are in both animals about 2 cm. long, the basal two-thirds of each hair being of the colour of a dark slate, the apical third being of a particular

shade of light brown nearly the same in both cases. The ventral surfaces are covered with shorter hairs each of which is grey with a fawn-coloured tip. In spite of these similarities the two specimens can be distinguished from one another with the greatest ease by passing the finger tips through the dorsal fur. In the female specimen the fur is soft and silky, indistinguishable from that of a *Nesokia hardwickei*, which almost equals prepared sealskin in softness. The fur of the male is harsh and bristly to the touch, because some of the hairs are of much greater girth than the majority and are pointed and stiff, others again are as long as 6 cm., of a black colour, and project far beyond the majority. In technical terms the fur of the male rat should be described as consisting of soft under fur, short spines and loug bristles, while the female specimen would be described as being totally devoid of spines or bristles. Between these two extremes the eighty-five specimens show every intermediate grade. The difference is to a certain extent a sexual one, for the whole collection does not show a single adult male specimen of the extreme soft-furred type. But although females are often soft-furred, some of them possess bristles and spines. There is no evidence that there is more than one race among the collection. However, an examination of groups of mole-rats from separate colonies or sets of burrows would doubtless show that the rats of some groups were collectively of the soft-furred type, while other groups would be more of the opposite type.

It is generally easy to distinguish a *Gunomys* of the Punjab from one of Calcutta. The soft sleek-furred type has not been met with in Calcutta. The mole-rats of the latter place always have harsh and bristly fur, soft under fur being scanty. Although in the Punjab rats bristles aud spines are usually present, soft under fur is also plentiful in every case. Calcutta mole-rats are generally of a cold dark greyish brown colour, Punjab ones being of a warmer and lighter brown, not infrequently of a reddish tint.

The skulls of the *Gunomys* from the Punjab resemble those from Calcutta, except that the molar series (and perhaps the palatine foramen) is on the average longer in the Punjab race. This is apparent to the eye as well as capable of being measured. It is, however, easy to find individual exceptions.

The following are the measurements of five chance-taken skulls from a mixed collection from the Punjab :—

Length.	Breadth.	Nasals.	Pal. for.	Molars.
42·5	25	12	9	9
100	58	28	21	21
40	25·5	12·5	9	9
100	62	31	22	22
38	23·5	11	9	8
100	61·8	29	23	21
43·5	26·5	12	9	9
100	61	28	20	20
45	27	14	10	9·5
100	60	31	22	21

Twenty Calcutta Gunomys (*Hossack*).

	Length.	Breadth.	Nasals.	Pal. for.	Molars.
Max. percentage ..	100	63·3	28·2	17·5	16·2
Min. percentage ..	100	58·2	31·8	22·9	19·7
Average ,, ..	100	59·8	29·3	19·2	18

The *Gunomys* of the Punjab and of Bengal are clearly of a different race.

Pjb. 6, *Nesokia sp.*—

We have received forty-five rats of this species from the Amritsar district. They were found living in the same part of the district and in precisely the same state as the *Gunomys*, but members of the two genera were always occupying separate colonies. The occurrence of these two genera, living side by side, is biologically interesting from more than one point of view. Incidentally it illustrates the modern meaning of the word "genus" as applied to mammals: the separation of the genera *Nesokia* and *Gunomys* was made by an eminent systematist [5]. When large numbers of specimens from the Punjab belonging to both genera are mixed together, it is difficult to separate them by their outward appearance. In colour and quality of the fur, members of the two genera are often indistinguishable; this is not surprising, as they are all found

burrowing in the same sort of soil. All the *Nesokiæ* have soft sleek fur, but some of the *Gunomys* resemble them in this respect. If a sleek *Gunomys* is placed in contact with a *Nesokia* so that the fur of both intermingle, the resemblance between the two is sometimes so great that not one point of difference can be appreciated. The members of both genera are variable in colour but in the same way. Those specimens of *Gunomys* which have harsh bristly fur can, of course, be readily distinguished from the soft-furred *Nesokia*; but because some of the *Gunomys* are sleek, a mixture of the two races cannot be readily separated by the appearance of the fur. In length the *Nesokiæ* vary from 134—186 mm.; the *Gunomys* from 163—236; length is therefore of less value than colour in effecting a separation. From a record of tail percentages of the two genera, presented in the diagrammatic form shown on plate v, it might be thought that this character provided a means of distinguishing the two races; however, the diagram shows that the *Nesokia* with the longest tail, and the *Gunomys* with the shortest, both have a tail percentage of 60, and the whole series of percentages range continuously from 49—83. The foot is of no more use than the tail in identifying individuals of the two races. In the Museum the two are distinguishable at a glance, for *Nesokia* has a very short palatine foramen and broad incisor teeth (plate iii). The difference between the two races must have been difficult to recognise in the field.

Captain Davys, however, noticed when opening the burrows of mole-rats that they either contained small litters of young ones (two to four) or large litters (eight to twelve); he also noticed that the rats found in the former kind of burrow were usnally smaller and had relatively shorter tails than those found in the latter. It was afterwards observed that females of the one race had few teats—almost invariably two pectoral and two inguinal pairs,—while those of the other race had a continuous row of about eight on either side. The difference in the number of the teats has long been known and led to the latter race receiving the generic name of *Gunomys* (the fruitful rat), the former retaining the name of *Nesokia.*

The difference between the apparent fertility of these two races is amazing when we consider that they are living side by side in neighbouring fields. If the *Nesokia* were the more fertile race, we should of course triumphantly point to this power as an explanation of the fact that the small race was able to live in competition with the larger *Gunomys*. It is, however, the *Gunomys* which appears to be two or three times more fertile than the *Nesokia*.

The lengths of all the undonbted adults received, twenty-four specimens in all, are shown on plate v; they vary in length from 134—197 mm. It happens by chance that these twenty-four specimens show about the same range of variation in length as exhibited by the eighty-five *Gunomys*. If many more *Nesokiæ* had been measured it is not likely that the range of variation would have become much extended. The measurements of *Mus rattus*, *Mus concolor*,

Nesokia and *Gunomys* all show that the range of variation in length is about 40 % of the mean length; the same is probably true of all small mammals. This is not usually admitted by systematists at the present day, although in 1871 J. A. Allen measured the length of twenty-eight adult squirrels and found that this comparatively small number exhibited a range of over 20 % of the mean [12].

In the case of *Nesokia*, however, there is considerable evidence that a pigmy race has arisen or is arising in a certain part of the Amritsar district. Some families of *Nesokia* were sent from a field near the village of Atari; these included four adults. In length these four measure 146, 147, 151, 155 mm., that is to say, they are all well below the mean. The similarity of the skulls of these four is remarkable.

The pigmy which measures 134 mm. is, however, from another part of the district. It was specially sent by Davys as it was pregnant, bearing two embryos. The third molars of this specimen are well worn down. Its maturity cannot be questioned.

Plate ii shows a series of seven *Nesokiæ* selected from the twenty-three to show gradation in length. Beneath them are shown the skulls of the same seven specimens. These skulls exhibit not only a difference in size, but a difference in form, for in the two marked S. B. B. 1 and S. B. B. 18 the ridges which mark the upper limit of the temporal muscles are visible but not prominent, and are set widely apart. In the skull P. C. M. 2 these ridges are more prominent and much closer together; this is the skull of the largest *Nesokia* we have received. The rats designated S. B. B. are the small ones from Atari already mentioned. Other skulls are intermediate in form as well as size between the two extremes. The measurements given below show how the small skulls resemble one another and differ from the larger ones in the proportions of the molar teeth.

The bodily proportions of *Nesokia* are shown on plate v. The percentage of the tail length in the length varies from 49 to 60, with an average of about 54. The discontinuity of the two genera is clear; there is not the slightest upward tendency in the line of the tail proportion (*Bt.*) shown by the largest *Nesokia*, although as regards length the two races overlap by a wide margin. The percentage of the hind foot is between 17 and 18, or about 1 % higher than in *Gunomys*, but in this character there is a distinct downward tendency in the line shown by the largest specimens (*Bf.*).

The skull of a *Nesokia* is easily distinguishable from that of a *Gunomys* owing to the abbreviating of the palatine foramen. The two races are quite discontinuous as regards this character, although they both show considerable variation (plate iii). Although this is the most obvious difference between the two types, it is not the essential one. The teeth, both incisors and molars, are much larger in *Nesokia* than in *Gunomys*. We can therefore see a reason for the abbreviation of the palatine foramen which has obviously been caused by the closing of the posterior half of that space. A

smaller skull being called upon to support more massive teeth responded by half closing its palatine foramen. On either side of the groove which indicates the closure is a bony eminence encroaching on the groove; if these eminences are opened the roots of the incisor teeth are discovered. The difference between the teeth of the two genera is great. In the smallest *Nesokia* (length 134 mm.) the incisors together measure 4 mm. in breadth. In one of the smallest *Gunomys* (length 165) it is only 3 mm. The measurements of the molar series are shown below. Even among the *Nesokiæ* themselves it is seen that the smallest skulls have the largest teeth not only relatively, but actually. A skull 42 mm. in length has a molar series of 7·5 mm. A skull of 35·5 mm. has molars of 9 mm. These are extreme cases. The difference in the appearance of the two skulls is striking. The skulls of *Gunomys* both from the Punjab and Calcutta do not, however, show the same tendency.

Measurements of ten skulls of Nesokiæ *from Amritsar.*

Designation.	Length.	Breadth.	Nasals.	Pal. for.	Molars.
A. T. W. 3 ..	{ 35 { 100	24 68	9·5 27	3·5 10	8 23
S. B. B. 1 ..	{ 35 { 100	23·5 67	10·5 30	4·5 13	8 23
S. B. B. 19 ..	{ 35·5 { 100	24·5 69	10 28	4 11	9 25

Nesokia and *Gunomys* all show that the range of variation in length is about 40 % of the mean length; the same is probably true of all small mammals. This is not usually admitted by systematists at the present day, although in 1871 J. A. Allen measured the length of twenty-eight adult squirrels and found that this comparatively small number exhibited a range of over 20 % of the mean [12].

In the case of *Nesokia*, however, there is considerable evidence that a pigmy race has arisen or is arising in a certain part of the Amritsar district. Some families of *Nesokia* were sent from a field near the village of Atari; these included four adults. In length these four measure 146, 147, 151, 155 mm., that is to say, they are all well below the mean. The similarity of the skulls of these four is remarkable.

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Plate ii shows a series of seven *Nesokiæ* selected from the twenty-three to show gradation in length. Beneath them are shown the skulls of the same seven specimens. These skulls exhibit not only a difference in size, but a difference in form, for in the two marked S. B. B. 1 and S. B. B. 18 the ridges which mark the upper limit of the temporal muscles are visible but not prominent, and are set widely apart. In the skull P. C. M. 2 these ridges are more prominent and much closer together; this is the skull of the largest *Nesokia* we have received. The rats designated S. B. B. are the small ones from Atari already mentioned. Other skulls are intermediate in form as well as size between the two extremes. The measurements given below show how the small skulls resemble one another and differ from the

ERRATUM.

In the table on page 29 the designation "S. B. B. 3" refers to the fifth series of measurements only.

the abbreviation of the palatine foramen which has obviously been caused by the closing of the posterior half of that space. A

smaller skull being called upon to support more massive teeth responded by half closing its palatine foramen. On either side of the groove which indicates the closure is a bony eminence encroaching on the groove; if these eminences are opened the roots of the incisor teeth are discovered. The difference between the teeth of the two genera is great. In the smallest *Nesokia* (length 134 mm.) the incisors together measure 4 mm. in breadth. In one of the smallest *Gunomys* (length 165) it is only 3 mm. The measurements of the molar series are shown below. Even among the *Nesokiæ* themselves it is seen that the smallest skulls have the largest teeth not only relatively, but actually. A skull 42 mm. in length has a molar series of 7·5 mm. A skull of 35·5 mm. has molars of 9 mm. These are extreme cases. The difference in the appearance of the two skulls is striking. The skulls of *Gunomys* both from the Punjab and Calcutta do not, however, show the same tendency.

Measurements of ten skulls of Nesokiæ *from Amritsar.*

Designation.	Length.	Breadth.	Nasals.	Pal. for.	Molars.
A. T. W. 3 ..	35	24	9·5	3·5	8
	100	68	27	10	23
S. B. B. 1 ..	35	23·5	10·5	4·5	8
	100	67	30	13	23
S. B. B. 19 ..	35·5	24·5	10	4	9
	100	69	28	11	25
S. B. B. 18 ..	36	25	10·5	4	8
	100	70	29	11	22
S. B. B. 3 ..	36·5	24	10	4·5	8
	100	65	27	12	23
	38	25·5	10	5	8
	100	67	26	13	21
	38·5	25·5	11	5	8·5
	100	66	28	13	22
	40·5	26	11	4·5	8
	100	64	27	11	20
	41	27·5	11·5	4·5	8·5
	100	67	28	11	20
P. C. M. 2 ..	42	27·5	11·5	6	7·5
	100	65	27	14	18

If these figures are examined it will be seen that the skulls of the *Nesokiæ* as compared with those of *Gunomys* are broader, have somewhat shorter nasals, very much shorter foramina, and longer molar series. They also show that on the whole the longest skulls have the smallest teeth; the longest skull of all—P. C. M. 2—also approaches the type of *Gunomys* in having relatively the longest palatine foramen. On the whole, however, there is no evidence that the longest skulls possess the longest palatine foramina.

There is little doubt that these twenty-four *Nesokiæ* represent two races, a larger and a smaller. The small race is perhaps confined to the immediate neighbourhood of the village of Atari.

Habits.—Before leaving the subject of the Punjab mole-rats, it must be mentioned that not a single individual was found in a dwelling-house or building of any description, although the measures against rats were so thorough that both *Mus mettada* and *Gerbillus indicus* were on rare occasions caught in dwelling-houses. This is most remarkable, for there is not the slightest doubt that the mole-rat, *Gunomys*, is a common house rat in Calcutta, Rangoon, Dacca and Darjiling.

Pjb. 7, Mus mettada—

Thirty-seven of these field rats have been received from Captain Davys. Of these fifteen are considered to be adult, though there is some doubt as to the maturity of the smallest of them. The large proportion of young ones in the collection is due to the fact that when this rather uncommon rat has been met with, one or both parents together with their brood have been dug out from a burrow and the whole sent together to the Museum. Usually a mature female with her brood of two to four young have been received. These families are all from the neighbourhood of Amritsar, but were obtained at different times and in different parts of the district. Some of the broods show characteristic peculiarities of their own, equivalent to the family likeness among mankind; although the peculiarities which constitute a family likeness are trivial in degree, they are measurable, and are as large as those on which "species" of rats have been (I do not say, usually are) established.

Because of a recent attempt [6] to split up the Mettads of a small part of India into three species, it has been thought well to give the full measurements of all the adults which we have received.

The whole collection of adults has been arranged in a series as regards their length. As the number dealt with is small, it is impossible to say what the mean length is; it is probably about 145. If, instead of arranging them in series, they are placed in groups according to occasions on which they were received, they present the following: Group A 132; B 154, 140, 150, 130; C. 114, 128; [illegible]; E 145, 134; F 142, 157; G 154; H 146.

Serial No.	Length.	Tail length.	Foot.	Ear.	Greatest length.	Greatest breadth.	Skull.			Remarks.
							Nas.	P. F.	M. S.	
1	114	.. ..	20	12	28	15·5	11	7	5·5	3rd molar cut and worn. Generative organs not quite mature.
2	117	99 (84%)	24	13	29	..	11·5	7	5·5	
3	128	96 (75%)	21	11	30	16·25	12·5	7·5	6	3rd molar much worn down. Adult.
4	130	92 (70%)	22	17	30	16·75	12·75	7·75	6	,,
5	132	100 (75%)	23	10	31	15·5	12	7·75	5·75	,,
6	134	103 (76%)	21	11	30	16·5	13	8	6·25	,,
7	138	102 (73%)	23	12	30	16	12·25	7·75	5·5	,,
8	140	115 (81%)	23	12	33	16·75	13·25	8	6	,,
9	142	115 (81%)	23	12	30	16		7·75	6	,,
10	145	120 (82%)	22	13	33·25	16·25	13 25	8·5	6·25	,,
11	146	.. ..	23	14	32	17	13·5	7·5	5·5	,,
12	150	.. ..	22	12	32·5	16·25	13·5	8	6	,,
13	154	.. ..	23	13	33	17	13	7·5	6·5	,,
14	154	105 (68%)	20	12	32·75	16·25	13·5	8	6	,,
15	157	130 (82%)	23	14	33	16·5	..	8·5	6	,,
		77%								

Each group was collected at a different time and from a separate colony. There is little indication of similarity in the members of particular groups. If we examine the proportions of the several litters of young ones, family likeness is apparent. We have received in all seven or eight of them, though some have become mixed.

The measurements quoted are of length and tail length.

Batch.	Length.	Tail.	Percentage.
E. D. L.	104	68	65
	105	73	69
D. I. G. (two or three broods mixed).	81	67	82
	82	63	77
	84	67	80
	92	74	79
	95	79	79
	78	63	80
	80	63	78
	81	58	71
S. M. P.	94	64	68
	91	66	72

Batch.	Length.	Tail.	Percentage.
F. E. M. (two or three broods mixed).	77	61	76
	83	76	91
	85	63	74
	85	65	76
	86	65	75
	89	73	82
	91	76	83

The four lots were received on separate occasions; the members of every brood must have been nearly of the same age except those of brood E. D. L. which are considerably older. The average tail percentage of the fifteen members contained in batches D. I. G. and F. E. M. together is 78·8. The broods E. D. L. and S. M. P. show values well below this average.

It might be thought that this was evidence of two separate races of *mettada* in the Punjab. However, an examination of the measurements of the fifteen adults does not confirm this idea. The peculiarities shown by the broods E. D. L. and S. M. P. are probably due to family likeness.

Colour.—All the specimens closely resemble one another in colour, the fur is about 15 mm. long and very soft, like prepared sealskin, the basal three-fourths of each hair is of a very dark slate-colour, the remainder being fawn-coloured, sometimes of reddish tint. Some hairs project beyond the majority and have black tips.

The tails are variable in colour, they are always lighter below than above, but whereas some are pure white below and scantily pigmented on the upper surface, others are lightly pigmented below and nearly black above.

Skull.—The principal measurements of the skull are shown above. The great length of the palatine foramen, and the antero-posterior curvature of the upper surface are the principal characteristics.

Habits.—It must be mentioned that Davys found these field rats in dwelling-houses on two separate occasions.

Captain Davys's operations extended beyond Amritsar into the Lahore, Jullundur and Lyallpur districts: in the foregoing description the collection has been treated as a whole.

The measurements of the Lyallpur rats are shown separately in the diagram, text-fig. 3. Unfortunately we have not as yet been able to deal with a large collection of *Gerbillus*, *Goalunda* and shrews which have also been received from Amritsar.

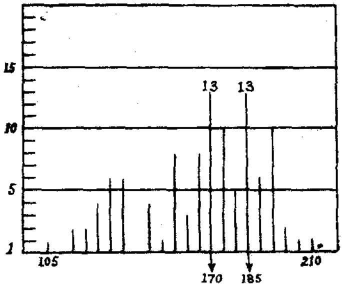

FIG. 3.—Diagram showing the length-frequency of 105 *Mus rattus* from Lyallpur (Davys).

Rawal Pindi.

Captain H. H. Broome has sent measurements and skins of fourteen *Mus rattus* from Rawal Pindi. They were selected from among a large number in order to show the extent of the colour variation. Two of them are white-bellied, the others are pigmented below but are variable above; in some the colour is light reddish brown, while in others the coloured element is much reduced and the general tone is much darker. The average length is approximately 180, but there is one specimen of 220 mm.

BALUCHISTAN.

Quetta.

Mr. W. A. Cummings has sent us a well-preserved collection of over fifty field rats from the neighbourhood of Quetta. He has also informed us that, so far as he can ascertain, there are no house rats in Quetta. His excellent collection of field rats gives support to this statement, for, as a rule, house rats are caught with much greater ease than field rats The relative number of the two kinds obtained from all parts of India shows this, but it must be remembered that Mr. Cummings, as the Honorary Curator of the Quetta Museum, has approached the subject as a naturalist, whereas most of our contributors have been Medical and Sanitary officers whose interest in house rats is special. For this reason I think that Mr. Cummings's statement requires confirmation. If it could be shown that the grain-sellers' shops of the Quetta bazaar are not infested with *Mus rattus*, and if the cause of their absence could be discovered, we should be in possession of important information.

More than half the collection is made up of *Gerbillus erythrura*, the well-known Afghan antelope rat, the feet of which have hairy

soles. Since this species has been excluded from a recent compilation of the genus *Gerbillus* (or *Tatera* [13]), it is probable that the name given in the *Fauna of British India* has not been accepted. The reason for this is not obvious, for the skull of the species is scarcely to be distinguished from those of the *Gerbilli* found throughout India.

Qta. 1—

The collection contains a number of *Nesokiæ* which, with one exception, very closely resemble one another in size, proportions and quality of fur. It has not been found easy to identify these with any particular species of *Nesokia.* They are a different race from the *Nesokiæ* found in the Amritsar district. They can best be described in comparison with these latter. The fur is longer, much more abundant, and of a lighter shade in the Quetta race.

Unfortunately measurements of the freshly killed specimens are not available, but it is likely that they are somewhat larger and have a slightly shorter tail than the Amritsar rats. One of them is shown in plate ii, fig. 1. The feet are certainly not larger than those of the other race. The skulls of the two races are indistinguishable, the large incisor teeth and the short palatine foramen being the peculiar feature in both. Judging from the stuffed specimens the average measurements of the race seem to be about 180, 95, 30, 18.

Qta. 2—

One specimen differs from the others in two respects: the fur coutains numerous long bristles 45 mm. in length, and the tail is somewhat longer. The latter point is not of much importance, but the former constitutes a striking difference, for all the others are quite devoid of bristles. Because of these peculiarities, it was at first sight suspected of being a *Gunomys*, but examination of the skull shows that it is a typical *Nesokia*, that is to say, it has a short palatine foramen.

In regard to the question of the absence of *Mus rattus* from Quetta, the following passage may be quoted from the *Bombay N. H. S. Journal*, vol. xviii, No. 4, 1908, page 942: "Mr. Anderson enquired if anyone had seen in Quetta the Indian house rat (*Mus rattus*). The reply was in the negative." The question was put to the members of the Baluchistan Natural History Society at Quetta.

THE RATS OF THE HIMALAYAS.

These must be considered together, for they collectively present certain differences from the rats of the plains. Moreover, there are among them several distinct races which are easily recognisable from one another. This enquiry has shown that the

house rats of India, so far as they have been examined, cannot easily be separated into distinct races, although in some districts they are of purer breed or less variable than in others. The greater racial separation among hill rats appears to be a necessary effect of their environment, which, by causing isolation, must encourage pure or inbreeding and lead to the establishment of dominant races. Apart from racial distinctions hill rats as a whole show certain characters. Their fur is long, fine and plentiful, and combines to form a warmer coat than that of the lowland rat. Moreover the tail of the hill rat is comparatively short. This is equally true of the rats of Kashmir, Naini Tal, Darjiling and Katmandu. *Mus jerdoni* is a rat which has an unusually long tail and spiny fur and seems an exception to the rule, but it is not the common rat of Darjiling at the present day; it is probably an inhabitant of the low slopes of the Eastern Himalayas.

The differences between the highland and lowland rats seem to be of the same nature as the differences between the races of mankind which are similarly situated. It is certain that racial distinctions are more frequent and more clearly defined among hillsmen than among plainsmen; it is hardly less certain that men of the various hill tribes of the Himalayas show collectively certain peculiarities. They are generally of shorter stature and stouter limb than the men of the plains.

Himalayan rats have been received from Srinagar, Simla, Naini Tal, Darjiling and Nepal. They present some interesting biological problems, the solution of which will require a wider investigation than has been carried out at present.

Kashmir.

We have received from Dr. Mitra of Srinagar the skins of ten rats caught in that district. One of these is a mole-rat of the genus *Gunomys.* The others belong to the *Mus rattus* group.

Ksh. 1—

Includes eight rats which were taken from a well-marked race. Although measurements of the freshly killed rats were not recorded, there is no doubt that the tails of all of them must have been shorter than is usual among the members of the *Mus rattus* group. When the dried tails are turned forwards and laid along the back, their tips do not reach the level of the ears. When the dried skins of lowland rats are examined in this way, they commonly reach the tip of the snout or beyond. There is little doubt that the tails of these Kashmiri rats were hardly as long as the combined length of the head and body.

In all the under parts are pure white. The dorsal fur, though somewhat variable in colour, is dull reddish grey. The component hairs are long, slender and very plentiful, and form a warmer coat than is found on lowland rats. Spines are

inconspicuous. Some of them have well-developed bristles which are in one case as much as ·5 cm. in length.

The characteristic feature of the race is the bicoloration of the tail. In all the lower surface of the tail is devoid of pigment, and is sharply marked off from the pigmented upper surface. The ears are covered with fine hairs which are longer and more plentiful than those found in lowland rats. This peculiarity is doubtless concomitant with the general plenitude of the fur. It causes the margins of the ears to appear as though fringed with white hairs. Microscopical examination, however, shows that the hairs of the margin do not differ, in the distribution and amount of their contained pigment, from the hairs which cover the whole outer surface of the ear. It was found that all the hairs on the ear are pigmented only in the stouter basal half,—the finer terminal half appears like clear glass beneath the microscope. The actual margin of the ear supports few or no hairs. The appearance of the white fringe received by the naked eye, is due to those hairs which, arising close to the margin, project beyond it. It will be seen that this detail is of importance. This race has been regarded as *Mus vicerex*. On page 358, vol. xvi of the *Bombay N. H. S. Journal*, Colonel A. E. Ward states: "We have practically settled that *Mus vicerex* is the common rat of Kashmir." From the context it appears that this determination was made at the British Museum, where the type of *Mus vicerex* from Simla reposes. The eight specimens forwarded by Dr. Mitra all agree in being reddish grey above and pure white below, in possessing short bicoloured tails and apparently white-fringed ears. These are the essential characters of *Mus vicerex*. It is, however, by no means certain that the Kashmiri race is in direct genetic relation with that rat found at Simla which is the type of *Mus vicerex*, for most of the races of Himalayan rats have short tails, and the white-fringed ear seems merely a concomitant of the general abundance of the fur. The same character is well shown by our specimens of *Mus blanfordi* (Nilgiri Hills), which species also possesses sleek abundant fur, but is certainly not closely related to *Mus vicerex*. The question whether bicoloration of the tail can be independently acquired on many occasions will be discussed later on. This particular character was met with in a single rat in Rangoon which appeared to be a sport; and also, in an unstable condition, among a small community of rats in Naini Tal. If we deny the possibility of its manifold origin we should do the same for the character of albiventralism, regard the white-bellied rats of Tellicherri, Cawnpore, Calcutta and other places as of one stock, and suppose that they hold themselves aloof from the other rats of those places.

The skulls of these eight rats do not seem to differ from those of the lowland rats.

The tail of one of the Kashmir rats, though darker above, shows a certain amount of pigment in the skin and hairs of the lower surface.

Ksh. 2—

This heading is reserved for one rat which possesses a unicoloured dark tail. The appendage is incomplete, so its length is unknown. The fur is plentiful, but the component hairs are shorter and stiffer than in most of the eight rats included in group Ksh. 1.

Ksh. 3, *Gunomys wardi*—

One specimen was obtained. The dry skin measured 220 mm. in length, the tail 120. The fur is long, soft and plentiful; bristles are present but inconspicuous. The skull has a long palatine foramen measuring 10 mm., the molar series being 1 mm. less than this.

Simla.

We have received from Captain G. I. Davys fifty-eight specimens of the *Mus rattus* type, and three mole-rats of this place. It was somewhat surprising to find that none of the fifty-eight possessed bicoloured tails, for this is the characteristic feature of *Mus vicerex*, a species which was described in 1903 from eleven rats caught in Simla. This anomaly is explained by the supposition that the eleven rats from which the type of *Mus vicerex* was chosen were all caught within one limited area in the Simla district. This supposition will be vindicated in considering the rats of Naini Tal.

Of the fifty-eight specimens nearly all are of the white-bellied type. As regards size and length of tail they scarcely differ from the Punjab type of *Mus rattus*. The collection contains many juveniles, but among rats measuring over 150 mm in length, those of 170 mm. are in the majority; but there are two specimens which measure over 200 mm.

The tail length is about 115 % of the length. This is short for *Mus rattus*, but not shorter than is found in some groups of the Punjab rats. The tails of all of them are black or blackish brown, and show the same depth of pigmentation on the upper and lower surfaces. The collection will be divided in the following manner:—

Sml. 1—

This group includes three rats which do not show white fur on any part of the body. They do not, however, closely resemble one another in colour. One of them is semi-melanotic; it is, however, a young rat, and such are generally darker in tone than adults.

Sml. 2—

This includes the remaining fifty-five, all of which show some white fur. They may be arbitrarily divided into the following sub-groups:—

Type A.—Contains seven specimens of the pure white-bellied type in which every hair on the belly, breast and throat is pure white.

Type B.—Contains twenty-three specimens which resemble type A but possess a colourèd line about one inch in length in the middle line of the breast between the fore legs.

Type C.—Includes twenty-six specimens which show areas of white fur on the ventral surface but which are not of types A or B. Some of these show a dark stripe in the mid-ventral line along the whole length of the under side. In others this line spreads outwards in a diffuse manner to meet the coloured sides, so that there are four isolated areas of white fur on the inner side of each of the limbs.

Sml. 3, *Gunomys sp.*—

There are three examples of this species which resemble one another very closely. They are of large size and are covered with coarse bristly fur, the bristles being stout and 6 cms. in length. The measurements are—

237	187	44	15
235	br.	45	15
247	br.	41	18

In colour they closely resemble the Punjab *Gunomys*, but they are somewhat larger than the largest of these. Their skulls measure—

Length.	Breadth.	Nasals.	Pal. for.	Molars.
47·5	27·5	14·5	10	9
100	58	30	..	..
48·5	29	14·5	10	9
100	59	30	..	..
45·5	27	13·5	9·5	9
100	59	30		..

Naini Tal.

The rats in the neighbourhood of Naini Tal were recently examined by the writer. Since plague preventative measures were not in force it was not possible to examine them in great numbers. Observations were made in five separate places. In the outhouses of the Naini Tal Brewery (alt. 5,000 feet)—five specimens. Bhowali Bazaar, a place situated about ten miles to the east of Naini Tal (alt. about 5,000 feet)—two specimens. Naini Tal Bazaar at the southern end of the lake (alt. 6,400 feet)—nine specimens. A European store at the northern end of the lake (alt. 6,400 feet)—four specimens. Two adjacent houses on Ayapata Hill with intervening outhouses (alt. 6,900 feet)—eight specimens. These

last are quite different from the others as regards coloration of the tail. Only those which were quite complete and freshly killed were measured. Several of them are immature.

	Length.	Tail length.	Foot length.	Ear length.	
Ntl. 1—					
Brewery ..	170	215 (126)	34	22	
	174	202 (116)	29	24	
Bhowali ..	205	200 (95)	32	22	
Naini Bazaar	170	200	30	24	
	150	152 (101)	30	22	Caught together—probably one litter.
	144	154 (107)	30	22	
	142	148 (104)	29	23	
Naini Store..	127	128 (100)	26	19	All immature—probably one litter.
	123	132 (107)	27	18	
	123	142 (115)	27	19	
Ntl. 2—					
Naini Ayapata House	125	138 (110)	30	22	
	105	107 (101)	27	18	
	147	162 (110)	29	22	
	150	169 (112)	29	22	
	162	180 (111)	32	23	
	185	197 (106)	32	26	

The measurements show that the tails of these rats are relatively shorter than those of lowland rats It is obvious that the rats of the Ayapata group do not differ in this respect from the rats taken at the level of the lake.

As regards colour the whole collection may be described together, for in this respect the members of it collectively resemble one another and differ from most lowland rats. The brownish element in the fur is present, but in abeyance, so that the general tone is dark grey. All of them appear white below, but two of them have coloured breast stripes, and in some of the Ayapata group every hair of the ventral surface is pale grey at the base; but at least three of this group have pure white ventral fur. A few of them have scanty fur with bristles and spines, and scarcely

differ from lowland rats in this respect, but in most of them the fur is plentiful, long and soft, and devoid of spines and bristles. Those with long soft hair usually have white-fringed ears. No type of fur is peculiar to any one local group. The individual with the longest and softest fur belongs to the Ayapata group, but the same group contains a specimen with somewhat bristly scanty fur. An old rat from the Brewery is conspicuous for the length and softness of its fur, which is devoid of bristles.

It must be strongly emphasized that the average quality and colour of the fur in the Ayapata group is not different from that of the rats found at the level of the lake. All are variable, but specimens can be readily selected from the Ayapata group and from the lake group which exactly resemble one another, except in the coloration of the tail. The truth of this cannot be too strongly expressed.

Ntl. 2, the Ayapata group—

The circumstances of the Ayapata group will be related in some detail as they are of great biological interest. Traps were set in a certain house on Ayapata Hill. The first capture was of two young rats caught together on the same night and in the same cupboard. These were so equal in their immaturity, that they were considered to be of the same litter. At first sight they did not seem to differ from the young rats of the bazaar. They were coated with soft dark grey fur, and their tails were relatively short. The tail of one of them was perfectly bicoloured, the lower half of its circumference was devoid of pigment and bore white hairs, the upper half was deeply pigmented and bore black hairs. The line of demarcation was sudden. The second specimen resembled the first except that the pigmented area of the upper surface did not reach to the tip of the tail, so that rather more than a third of the terminal portion of the tail was white in its whole circumference.

These two specimens caused great perplexity. By every systematic rule they should be of different species, each, again, being different from that found in the bazaar. The specimen with the completely bicoloured tail should be either *Mus vicerex* or *Mus niveiventer*, both of which species occur in the Himalayas and have short bicoloured tails; it is especially like the latter, which has greyish fur. The other specimen, in its partially bicoloured tail, resembles *Mus berdmorei* [4], a species which has been found in Manipur and Tenasserim, but uot in the countries between. The circumstances, however, plainly indicate that these two rats are of the same race and that they are more nearly related to the rats of Naini Bazaar than to *Mus niveiventer*, which was discovered fifty rat-generations ago in Katmandu but has not been rediscovered.

Traps were set in a neighbouring house and in the intervening outhouses, with the result that six more rats were caught; the tails of all of them were pure white below, the pigmentation of the upper surface extending along the tail to a variable distance

from the root. In only one specimen does the dorsal pigmentation reach to the tip of the tail; plate iv, fig. 4, shows the tail of this rat as viewed from the side. In four specimens the pigmentation reaches only a short distance, so that most of the upper surface as well as the lower surface is pure white (fig. 1). In three others it reaches up to or beyond the middle of the tail but does not reach the tip; the tail of one of these latter, which was preserved in alcohol, is shown in plate i, fig. 2*b*. It was not possible to photograph the others for they were preserved as stuffed skins, in which state the lower surface of the tail is yellowish grey like old parchment, and that sharp contrast which is so necessary for photographic reproduction is lost. The figures on plate iv were drawn from the stuffed specimens. The contrast between the pigmented upper surface and the lower surface is much better shown in plate i, which is a reproduction of a photograph.

The partial albinism of the tail of each of these rats shows clearly that they must be of intimate relationship; they are in fact a large family group or a small race, but one cannot tell, from the eight specimens, what the type of that race is.

The single specimen with the wholly bicoloured tail resembles, as regards its tail, many known species,—*Mus vicerex, niveiventer, jerdoni, bukit, rapit*, all these being highland rats. This single specimen, however, cannot be considered as the "type" of the group. At least two of them, one of which is illustrated in plate i, resemble *Mus berdmorei* of Tenasserim and Manipur.

The skulls of these rats are of the *Mus rattus* type. The biological interest of the group is further discussed on page 89.

Darjiling.

A small collection was recently made in this district by Mr. Hodgart. This includes five of the *Mus rattus* group and eleven mole-rats. The five specimens of *Mus rattus* are from three separate places—Darjiling, Ghoom and Sonada. They will be considered together with five rats which were caught by Dr. Hossack in Darjiling.

Djl. 1—

The ten rats resemble one another so closely that they must be members of one pure-bred race; their skulls are of the *Mus rattus* type; they are covered with abundant long soft fur, in which the brown element is so poorly developed that the tone of the dorsal surface is almost black. Each hair on the ventral surface is of a dark slate-colour, with a fawn-coloured tip. The tails are much shorter than those of lowland rats. In every specimen, the upper surfaces of the feet are covered with white hair, the soles being deeply pigmented. This race is as distinct as the Kashmir race, Ksh. 1, which it resembles only in the softness of the fur and the shortness of the tail. Dr. Hossack, who considered the race to be *Mus nitidus*, observed that the tails of these Darjiling rats were somewhat lighter below than above. The tails of rats from many

other places show this peculiarity, especially if they are thoroughly washed in alcohol. The Darjiling race is quite different from the Kashmiri and Naini races, in which not only the lower surface of the body but also that of the tail is pure white. The measurements of the ten specimens are as follows :—

	Length.	Tail length.	Hind foot.	Ear.
Darjiling Telegraph Office	183	181	36	21
	180	166	36	24
Ghoom Bazaar ..	198	207	36	22
Sonada	147	131	32	20
	178	162	37	22
Darjiling rats (Hossack)	180	..	37	21
	130	135	33	20
	130	140	32	20
	195	185	36	22
	185	185	35	22

The measurements are of freshly killed rats with unbroken tails. Three of these rats are immature. The measurements show that the average length of the race is about 180 mm. and that the length of the tail is somewhat less than that of the head and body.

Djl. 2—

Eleven typical specimens of *Gunomys bengalensis* were caught in the houses of the bazaar at Darjiling, Ghoom and Sonada. They are thickly furred and bristly, but differ from the Simla group 3 in size. An average specimen measures 197, 142, 33, 21. They seem to be common house rats in Darjiling ; they were caught during the rainy season.

Nepal.

Thanks are due to Lt.-Col. J. Manners-Smith who, despite more than one unsuccessful attempt, eventually succeeded in sending two consignments of live rats to the Indian Museum, as well as a number of specimens in alcohol.

We have received in all nine house rats, eight mole-rats and a bandicoot.

Npl. 1, *the rattus group*—

The rats of this group which we have received from Katmandu belong to a distinct race, distinguished by the large size of its

members and the abundance of their fur. Our conclusions are based on the examination of four rats which were received alive, and confirmed by an examination of five specimens received in alcohol. The measurements are—

205	220	37	28
234	225	37	27
210	210	39	26
206	227	38	27

Considering these measurements and judging also from the five spirit specimens, we may conclude that the average length of the members of the race is about 210 mm., and the average tail length some 5—10 mm. more than this. The hind feet are relatively short. The fur is remarkable for its length and density, spines are absent in some, present but inconspicuous in others. Slender bristles 4—5 cm. in length are present in all.

The general colour of the fur is not unlike that of *Mus decumanus*; the brown element is well represented, the terminal quarter of each hair being yellowish brown. In this respect they differ from the darker rats of the Darjiling race (Djl. 1).

The hairs of the ventral surface are long and plentiful, with grey bases and reddish fawn-colonred tips. The whole circumference of the tail is deeply pigmented. The ears, unlike those of most thickly furred rats, are covered with very short inconspicuous hairs; except for their size, the skulls show no constant peculiarity.

Npl. 2, *Gunomys tarayensis* (?)—

There are eight specimens from Butal, a place situated in the plains on the Nepalese frontier. They were taken from burrows in the fields.

They closely resemble one another and are remarkable for the length and density of their fur; an average specimen measures 196, 140, 31, 21. Their skulls resemble the *Gunomys* of Calcutta.

Npl. 3, *Bandicota nemorivaga*—

One specimen from Katmandu must be referred to this species; it is not more thickly furred than the members of the same species found in Calcutta, and it appears to be indistinguishable from these in every way; it was found burrowing in the gardens of the Residency. It measures 260, 225, 50, 30. The length of the nasal bones is 34 % of the total length of the skull.

THE UNITED PROVINCES.

Allahabad.

We have received the measurements and skins of 182 rats from Lieut. Palmer. This useful collection consists entirely of *Mus rattus*. The frequency with which rats of different lengths occur, is displayed by the upright lines in the diagram, text-fig. 4. This shows

that the rats of 165 mm. in length are in the majority, but that rats of 200 and 205 mm. are to be found. This diagram agrees with that which displays the length-frequency of the Punjab rats, text-fig. 1. The difference of 10 mm. between the maxima in the two cases is accounted for by the fact that in the Punjab the measurements were taken from the first ring of the tail to the snout, while at Allahabad they were taken from the anus to the snout. The distance between the anus and the first ring of the tail in an average sized rat is about 10 mm. It must be emphasized that these measurements were recorded by two different persons, both un-

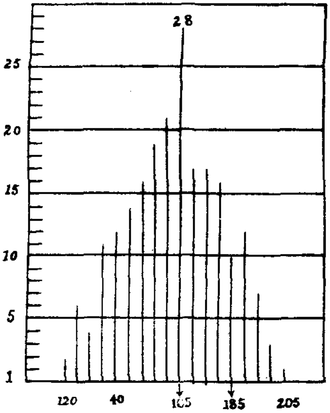

FIG. 4.—Diagram showing the length-frequency of 182 *Mus rattus* from Allahabad (Palmer).

acquainted with the purpose to which their records were to be put, and that, without excluding immature specimens, all the measurements have simply been sorted into groups and represented in the diagrams. They show conclusively that a rat of 145 mm. and one of 205 mm. may be of the same race. It has been already shown, in mentioning some of the latest additions to Indian mammalian fauna, how little this fact is realised.

In the proportions of the tail, feet and ears, the Allahabad rats do not seem to differ from the rats of Calcutta, as described by Hossack. According to the colour of their fur they may be divided into three groups.

Alh. I—

Includes 169 rats of the yellowish brown dark-bellied type. They are variable in the colour and character of the fur, and

especially as regards the bristles and spines. They are included in one group because they show no white fur on the abdomen although some are lighter below than others.

Alh. 2—

Includes twelve rats differing from the others in being white below. These do not show the coloured stripe in the mid-line of the breast which is often present in white-bellied rats. In one of them although the ventral fur appears pure white, each of the component hairs is light grey at the base; in the others every hair is white in its whole length.

Alh. 3—

Includes one albino specimen; it is of a pale straw-colour rather than pure white. The ears, nose and feet are devoid of pigment.

Cawnpore.

Captain H. Fulton has sent the measurements and stuffed skins of thirty-one specimens of *Mus rattus*. The lengths of these are displayed in the diagram, text-fig. 5, which shows that rats of about

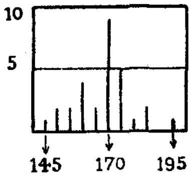

FIG. 5.—Diagram showing the length-frequency of 29 *Mus rattus* from Cawnpore (Fulton).

170 mm. are clearly in the majority. This collection has been made with particular care, and does not include any specimens of doubtful maturity. The diagrammatic representation of these measurements is therefore of special interest. In regard to proportions there seems little difference between the rats of Cawnpore and of Calcutta. The average tail-length among the group is a little over 120 % of the length of the head and body. The collection falls naturally into three groups according to colour.

Cnp. 1—

The eye can distinguish two of them from the others at a distance of fifty yards owing to their black colour. On close inspection it is seen that they do not entirely resemble one another. In one specimen, a male measuring 145, 188 (br.), 31, 32, the back is covered with hairs most of which are dark slate-grey in the lower two-thirds of their length, and black in the upper third. Intermingled

with these are numerous flat, pointed spines of a light grey colour, with black tips. Besides these there are many slender bristles, about 3 cm. in length and black in colour, showing a dark green iridescent lustre. The green lustre can be seen on a single extracted hair if light comes to it at a particular angle; it is often to be seen on the bristles of *Mus rattus*, especially when they are wet. There is no sign of a yellow or brown tint in any of the hairs. The ventral fur is dark slate-grey. The second specimen, a female measuring 144, 201, 33, 24, is at a yard's distance almost indistinguishable from the other; close examination, however, shows that it differs in the following respects. The light grey spines are much less numerous, and less conspicuous among the fur. The bristles are not more than 2 cm. in length and do not show iridescence. There is a brownish element in the general colour. The fur of the flanks and shoulders especially shows a distinct trace of yellowish brown.

It is remarkable that these two black rats, although obviously mature, are the two smallest specimens in the whole collection. There is some evidence to show that the black *Mus rattus* is usually smaller than the brown. Hossack, in speaking of the few black rats obtained in Calcutta, says, "except that none of the eight exceed 16·5 cm. in length, there is nothing in either the body or cranial measurements to distinguish them from normally coloured rats." We have received four black and three brown specimens of *Mus rattus* from Freemantle, Australia. The former are all smaller than the latter.

It has been shown in describing the rats of Rangoon that blackness is not associated with smallness in the allied genus *Gunomys*.

The skulls of these two black rats from Cawnpore are somewhat unlike one another; although there is only half a millimetre's difference between their total lengths, there is a difference of 2 mm. between the lengths of their nasal bones.

Cnp. 2—

Includes seven specimens in which the fur covering the lower surface of the throat, breast and belly is white. In two of these the ventral fur is long and pure white, perhaps with a faint tinge of lemon-yellow, but there is no coloured stripe in the middle line of the breast. In the other five there is some colour in this situation; in one the hairs in the mid-pectoral line are pale grey, in another pale grey tipped with fawn, in a third the coloured line is very distinct and joins a transverse line which crosses the breast between the fore legs.

Cnp. 3—

This includes the remaining nineteen, all of which are dark-bellied, each ventral hair being, as usual, dark grey, tipped with yellowish or reddish brown.

In order to be able to express the amount of difference in appearance between the members of these groups, the writer ascertained by trial the longest distance at which a person of normal vision could distinguish the three kinds from one another. It was found that in a good light the three could be easily named at a distance of thirty yards, and less easily even up to fifty yards.

On the one hand, we have seen in discussing *Mus listoni* and *M. comberi*, that at the present day species are founded on such small differences that the fact of their being at all appreciable by the naked eye is considered noteworthy, while on the other hand we now see that differences which are appreciable at a distance of 50 yards are not considered of specific value. This is the natural outcome of the conviction that organisms of any particular species—elementary or indivisible—can only give birth to offspring of the same species. This conviction is of course based on the common experience that like as a rule gives birth to like. The belief that there are no exceptions to this rule is so strong that evidence afforded by the eye cannot be believed, and certain species have been considered indivisible but polymorphic. *Mus rattus* is one of these. All who have written about Oriental rats are agreed that the common brown *Mus rattus* (*alexandrinus* or *rufescens*) usually has a brown belly, but that there is a second form with a white belly, and some have justly considered that the black rat is merely a third form. But all have regarded the two or the three forms as one indivisible species. It has been felt that to regard them otherwise would be to admit the discontinuous and manifold origin of species.

Although it is difficult to gauge the general opinion of biologists from the writings of individuals, it seems that this admission, so distasteful to many, is gaining in favour at the present day; the evidence afforded by the rats of India seems to be in favour of it.

Hardwar.

Mr. Pitambar Paul has sent a useful collection of fifty *Mus rattus* in alcohol, with measurements of each.

The lengths of these range from 140 to 200 mm. A large number of immature individuals have been included, but there are more rats of 180 mm. than of any other length. If their lengths are arranged according to their frequency they show the same kind of diagram as text-fig. 2, in which the measurements of a large number of immature rats were included.

As regards colour they are all of the brown dark-bellied type found commonly throughout Northern India; two of them are white-bellied with a broad coloured stripe in the middle line of the breast and abdomen.

Ballia.

The Civil Surgeon of Ballia has sent a typical dark-bellied *Mus rattus*.

Gonda.

We have received eighteen rats in alcohol from the Civil Surgeon of Gonda. Sixteen of these are of the brown, dark-bellied type of *Mus rattus*, and show no peculiarities; two are typical examples of *Gunomys bengalensis*, probably from the fields.

Ghazipur.

Mr. R. S. Misra has sent the measurements, skins and skulls of seven rats. All are brown specimens of *Mus rattus*; two of them have white bellies, the others being of the common dark-bellied type.

Azamgarh.

The Civil Surgeon of this place has sent four brown, dark-bellied *Mus rattus*.

Saharanpur.

Mr. K. V. Amin has sent two house rats and a shrew. The rats are large examples of the common brown, dark-bellied type of *Mus rattus*. Their lengths are 193 and 200 mm.

Moradabad.

Lt.-Col. M. Cadell has sent four specimens of *Mus rattus*; they are of the brown, dark-bellied type. Their lengths are 162, 181, 185, 190. Their proportions are normal.

Bulandshahr.

Captain K. J. Walton has sent five brown, dark-bellied *Mus rattus* of ordinary size and proportions.

Lucknow, Rai Bareili, Dehra Dun, Agra.

Mr. P. Stebbing has sent four rats from Dehra Dun, Mr. R. A. Hodgart has obtained ten from Lucknow and one from Agra, and there are four from Rai Bareili sent by an unknown correspondent. These nineteen rats closely resemble one another; they are all of the common yellowish brown, dark-bellied type of *Mus rattus* obtained from Allahabad, Cawnpore and many other places.

CENTRAL INDIA AND THE CENTRAL PROVINCES.

Nowgong.

Captain J. Skinner has sent the large number of 115 rats with the measurements of each. Of these eighty-one are *Mus rattus*, one is *Mus mettada*, and the remainder are *Gerbillus indicus*. The lengths of the house rats are shown in the diagram, text-fig. 6; they vary from 150 to 210 mm., those of 180 and 185 being in the

majority. The rats of Nowgong therefore appear to be somewhat larger than those of other parts of India, but this may be due to some peculiarity in the recorder's method.

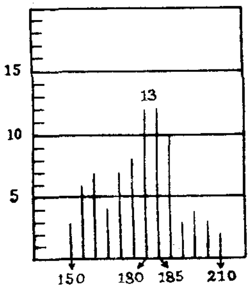

Fig. 6.—Diagram showing the length-frequency of 81 *Mus rattus* from Nowgong (Skinner).

In their proportions and in the colour of the fur they show no peculiarities; they are all of the yellowish brown, dark-bellied type. One of them shows a clear white streak in the middle of the breast like the rats shown in plate i.

The single specimen of *Mus mettada* does not seem to differ from the Punjab Mettad.

It has not been found possible to include *Gerbillus* in this report.

Buldana.

We have received fifty-three dried skins and skulls from Mr. Srinivaslu Naidu. This collection contains twenty-two *Mus rattus*, twenty-three *Gerbillus indicus*, four *Gunomys bengalensis* and four *Mus mettada.*

Bld. 1, *Mus rattus*—

These are of the yellowish brown, dark-bellied type; all are somewhat darker than usual, and resemble one another closely.

Bld. 2, *Mus mettada*—

There are four dried skins and skulls of these field rats. The skins have been stretched in drying so that they do not directly indicate the size of the rats from which they were taken. Two of them are about 180 mm. in length, the other two being about 150. Teats can be found on the smaller skins only, so that the difference in size, which in the live rats was probably only about 20 mm., is most probably sexual. It is, however, possible that

the smaller and the larger were taken from different colonies. In fur quality the four resemble one another very closely; they differ from the Punjab Mettads in having shorter and darker fur. In the latter the length of the dorsal hairs is about 15 mm., the colour dark slate-grey with about 3 mm. of the terminal portion of a reddish fawn. In the Buldana Mettad the fur is about 10 mm. in length, the coloured terminal portion being about 2 mm. in length. In both the fur is as soft and silky as mole-skin. No constant differences can be found between the skulls of the two races.

The lengths of the palatine foramen and the upper molar series in each of the specimens is as follows: 9 and 6, 8·5 and 6·5, 8 and 6, 8·5 and 6. The large excess in the length of the palatine foramen is well known to be the characteristic feature of the skull of this species.

Bld. 3, *Gunomys bengalensis*—

The four skins have evidently been taken from large rats, one skin measuring as much as 270 mm. from snout to root of the tail; the rat from which it was taken probably measured as much as 240 mm. Two of the others must have been about 200 mm. in length, and the fourth about 175. There is a considerable difference in the character of the fur of the four specimens. They are all greyish brown, but the two medium-sized specimens have very light coloured bellies sharply contrasting with the darker sides, while in the largest specimen the belly is dark and this contrast is not seen.

It happens that the two light coloured specimens very closely resemble a skin of a *Gunomys* from Chingleput in Madras,—much more closely than they resemble the other specimens from Buldana.

In spite of the differences in colour the skulls of the four resemble one another very closely, all being considerably narrower than the average skull in a mixed race of *Gunomys* such as is met with in Calcutta. They resemble in this respect the skulls of the melanotic race of *Gunomys* found in Rangoon, but are somewhat narrower even than these. It is probable that increased size is correlated with diminution in the breadth of the skull, as in *Gunomys varius* and the genus *Bandicota*.

The measurements of these skulls are as follows:—

Length.	Breadth.	Nasals.	Molars.	Pal. for.
39·5	22·5 (57 %)	12·5	8·5	7·5
43·5	24·5 (56 %)	13	8·5	9
44	24·5 (55 %)	14	8·5	9·5
46	25·5 (55 %)	14·5	9·5	9·5

The breadth percentage of the skull in twenty specimens of *Gunomys bengalensis* taken from different parts of Calcutta varies from 58·4 to 63·3, the average being 59·8 (Hossack). It has also been shown that this percentage among *Gunomys* from the Punjab and other places is on the average about 60.

So far as we can judge from four specimens, the *Gunomys* of Buldana form a distinct race; it may be confined to a single set of burrows, for the same peculiarity, though to a lesser extent, was found among the rats of two adjacent houses in Rangoon.

Rewa, Burwani and Dhar.

From these neighbouring States in the west of Central India we have received twenty-one specimens of *Mus rattus.* All are of the brown-bellied type. Measurements of each have been received, and show that in proportions and size the common rats of these districts are normal. Mr. Ahia Ali Khan of Rewa has sent ten, Mr. P. L. Bhattacharya of Burwani has also sent ten, and the State Surgeon of Dhar has sent one.

Neemuch.

Captain A. Meaden has sent four similar rats from this place.

Sambalpur.

Captain J. C. Gillmore has sent two specimens of *Mus rattus*; the lengths of these are 162 and 193 mm. There is nothing remarkable about their proportions. The dorsal fur is of a reddish brown colour. They are both of the pure white-bellied type, every hair on the throat, breast and abdomen being pure white from root to tip, and the white ventral surface is sharply marked off from the coloured sides.

BENGAL.

Calcutta.

Dr. Hossack has dealt with the rats of Calcutta so fully that little need be said in regard to them. Though admitting that the material on which his conclusions were based was somewhat limited, he was inclined to the opinion that the bandicoots of Calcutta and Madras were of the same species. We have since obtained a number of bandicoots from both Calcutta and Madras, so that this question may be re-opened. The meanings of the word "species" are such that it is difficult to decide the question whether these two groups should constitute different species or not; there is, however, no doubt that they are different races, and therefore, according to modern systematists, should be regarded as different species.

The measurements of the bandicoots of Madras city will be given presently. The measurements of six specimens from Calcutta

are given here for comparison. It may be mentioned that both sets of measurements were taken by the same hand.

	Length.	Tail.	Hind foot.	Ear.
A	235	215	50	28
B	260	244	49	29
C	260	239	52	32
D	277	251	51	24
E	278	235	53	30
F	295	br.	52	29

The skull measurements of these are as follows :—

	Length.	Breadth.	Nasals.	Pal. for.	Molars.
A	54	28·5 (53 %)	br.	10·5	10
B	55·5	28·5 (51 %)	19 (34)	11	11
C	..	..	..	..	..
D	59	31 (53 %)	21 (35)	11	11
E	58	32 (55 %)	20·5 (35)	10	11
F	59·5	32 (53 %)	21 (35)	11	11

Comparing these figures with those given for the Madras bandicoot, we see that the latter are somewhat larger, have longer tails and longer nasal bones. The fur of the Madras rat is harsh, bristly and scanty. That of the Calcutta rat is also bristly but longer, softer and much more abundant. There is little doubt that individuals of both races could be found, which in one or more of the distinguishing characters would be intermediate between the two. The races, however, are none the less separate.

Purneah (Behar).

Mr. C. A. Paiva, of the Indian Museum, has made an interesting collection of field rats in this district; twenty-two of them are *Gunomys bengalensis*, three are *Bandicota nemorivaga*.

Those *Gunomys* which were measured in the fresh state have the following proportions :—

Length.	Tail.	Hind foot.	Ear.
165	. 125	26	22
165	132	30	20
175	138	31	25
175	120	31	22
175	139	30	22
175	162	31	22
180	166	31	22
180	126	32	22
185	139	26	22

The mean length of the members of this group is therefore considerably less than that of a mixed collection of the same species taken from Amritsar. These twenty-two rats may not, however, represent the mole-rats of the whole district of Purneah, for they were all taken from one colony or set of burrows.

In colour and quality of fur the members of this group are constant and are indistinguishable from the *Gunomys* of Calcutta, and like them they show differences from the *Gunomys* of the Punjab. In tail-length they are somewhat variable, but in the length of the hind feet they are more so. There are two adult specimens among them of approximately the same length. The one, a stoutly built male, has a hind foot measuring 35 mm. The foot of the other, a lightly built female, only measures 26 mm. The difference in appearance is striking. The females, however, do not constantly possess small feet.

The skulls vary in the same way and to the same extent as those of the Calcutta *Gunomys*.

The three bandicoots cannot be distinguished from *Bandicota nemorivaga* of Calcutta. Their measurements are—

A	238	200	46	24
B	250	231	52	22
C	275	250	51	28

A and B are females; neither seems quite mature. C is an old male. The last centimetre of its tail is pure white. This peculiarity has often been met with in other species. The skull of B is broken. The measurements of the others are as follows :—

	Length.	Breadth.	Nasals.	Pal. for.	Molars.
A	48·5	27 (55 %)	16 (33 %)	9·5	10
B	57	31 (55 %)	20 (35 %)	11·5	12

Puri (Orissa).

Dr. N. Annandale obtained two specimens of *Mus rattus* from the neighbourhood of Puri. Both are of the white-bellied type. In one of them, an immature specimen, the colour of the belly is pure white, in the other, an adult of normal size and proportions, the belly is light lemon-yellow; it resembles very closely the rats from Travancore.

MADRAS.

Madras City.

The rats of Madras city were examined by the writer during February of this year, when about 700 were brought in daily from different parts of the city. The different species were separated and their numbers counted on two occasions. The results were as follows :—

	Mus rattus.	Bandicoots.	Mice.	Shrews.
1	392	92	220	28
2	275	82	143	15
TOTAL	667	174	363	43

Besides these, other species were occasionally obtained. In four days one specimen of *Mus mettada*, three of *Vandaleuria oleracea*, one *Gunomys* sp. and two *Gerbillus cuvieri* were brought to the collecting station; these were most probably from the fields. Further counts were not made, as the numbers did not vary much from day to day.

These numbers cannot accurately represent the numerical proportions of the species actually present in the city. Probably the bandicoots are present in much larger numbers than they appear, for they must be more difficult to capture than the others. Examples of *Mus rattus* were frequently brought, two or three in one trap. The bandicoots were never trapped owing to their size. Almost all of these large rats were killed singly by blows from sticks. That this was the means by which they were obtained, was known not only from the assertions of the rat-catchers but also from the condition in which the dead bandicoots were obtained. Among large numbers examined it was difficult to find specimens the skulls of which were in an unbroken condition; this difficulty was never felt in the case of other species. That it was possible to obtain nearly 100 bandicoots daily by such a method, shows that this formidable rat must be very plentiful in Madras.

Not a single specimen of *Mus decumanus* was obtained. It is difficult to assert that this rat, which is so common in other Indian ports, does not occur in Madras city. The evidence of its absence, however, seems almost conclusive.

Some hundreds of rats were being received daily during several months. From these one specimen of a greyish short-tailed rat was sent to the Madras Museum suspected of being *Mus decumanus*. This was examined by the writer, the skull being removed. It was obviously a *Gunomys*.

The rarity or absence of *Mus decumanus* can, however, be explained. The port of Madras differs from the other great ports of India. Long lines of wharves with steamers moored alongside are conspicuous features of the ports of Calcutta, Bombay and Rangoon. In the smaller port of Madras the conditions are different and steamers usually unload their cargoes at a jetty or by means of small boats. These conditions would deter the ships' rats from invading the shore in great numbers, but could not prevent the invasion altogether. A more potent factor in determining the suppression of *Mus decumanus* awaits those that reach the shore.

These large rats are well known as dwellers in the drains and outhouses of the ports of India, where they can sustain themselves in competition with other species. In Madras, however, they meet, to their detriment, with a larger and still more formidable race, the bandicoots, whose mode of life is remarkably like their own. A similar explanation may be given of the comparative scarcity of *Mus decumanus* in Rangoon, for in that city the large mole-rat, *Gunomys varius*, which was spoken of as "bandicoot" by the rat-catchers, is the common out-door rat. This race would compete successfully with *Mus decumanus* in the same manner though not with such complete success as the Madras bandicoot, for in the struggle the two races would be on more equal terms. In Calcutta and Bombay, *Mus decumanus* thrives with little competition. The bandicoots of Calcutta are rare and live in burrows after the manner of field rats, especially around the numerous tanks of that city. That competition and enmity between the different races of rats actually exists will be shown later (Appendix III).

Mds. I, *Mus rattus*—

The rats of this group were examined somewhat superficially, few measurements being recorded. On inspecting a large number of them the general impression was received that they were somewhat smaller than the rats of other parts of India. The few measurements that were made confirmed this impression. It is not unlikely that the mean length of the race in Madras city is as low as 160 mm. or 1 cm. less than that of the race found on the west coast of Madras.

They were on the whole less variable than the western race. Melanotic and white-bellied varieties were not met with.

Mds. 2—

An interesting variety was found showing a pure white streak in the middle line of the breast. Two specimens showing this peculiarity were obtained. One of them in which the white line is of considerable length is shown in plate i, side by side with a rat showing the same character which was caught in Bombay. The same peculiarity has been noticed in Calcutta.

Mds. 3. *the large bandicoot*—

This species was long known as *Nesokia bandicota.* Since however, the new genus *Bandicota* has been established, it should presumably be known as *Bandicota indica* [11].

Proportions.—The first five adults met with were measured. The results were as follows :—

270	285	54	30
273	275	55	28
290	311	58	30
300	302	58	28
310	310	56	31

It is surprising to find that the tail-length is equal to or even slightly greater than the length, for these rats have previously been described as possessing tails less in length than the head and body.

Fur.—Almost every specimen was scarred and mangy, the fur being always sparse and very bristly. It consists of a soft under fur which is scanty and of a dull grey colour, from among which spring numerous spines, grey in colour with cream-coloured ends. These spines measure 2 or 3 cms. in length ; the longest ones are tipped with black. The fur of the back also contains long bristles, 6 or 7 cms. long, which are black in most of their length. It is an interesting fact that the fur of these rats is much more like the fur of *Gunomys varius* of Rangoon, than that of *Bandicota nemorivaga* of Bengal, the fur of which is comparatively soft and very thick. This can be explained by the fact that the Madras and Rangoon "bandicoots" are both drain-haunting town rats, whereas the Bengal bandicoot is a burrowing field rat. It is difficult to distinguish a piece of the excised skin of the Madras and Rangoon forms from one another, whereas both could be readily distinguished from that of a Bengal bandicoot. There is not, however, the slightest doubt that *B. indica* and *B. nemorivaga* are much more closely allied to one another than either of them is to *Gunomys varius.* A similar observation was made in the Punjab, where the thick fur of the *Gunomys* and *Nesokia,* which burrow in the same fields, is often of precisely the same quality, but quite different from the sparse fur of the *Gunomys* of Bengal.

Skull proportions.—The measurements of five skulls are as follows :—

Length.	Breadth.	Nasals.	Pal. for.	Molars.
63 100	34 53·9	26 41·2	12	10
60 100	32 53·3	23·5 39·4	11	10
56 100	Br.	23 41·0	11	11
59 100	Br.	25 42·3	11	10
56 100	Br.	22 39·3	10·5	10·5

The Madras bandicoot differs from *B. nemorivaga* in being somewhat larger, in possessing sparse fur and a longer tail. In the skull the nasal bones of *B. nemorivaga* are about 35 % of the total length. In the skull of the Madras bandicoot this percentage is about 40.

Habits.—It was not possible during a short visit to become personally acquainted with the habits of these rats. Some interesting information was obtained from others. It has been already pointed out that the bandicoots must be very common in Madràs city. Dr. J. R. Henderson informed me that in certain streets of Madras, in which the drainage system was partly of an open nature, bandicoots could often be seen running about the roads during the still hours of the night. Dr. K. T. Matthews, Health Officer of the Municipality, also showed me some interesting facts regarding the habits of these rats. Most of the houses in Madras city contain a central courtyard which is tiled and open to the sky. Waste water from this yard leaves by a closed drain which pierces the front foundations of the house to enter the main drain of the street. At night the bandicoots enter the houses by means of these drains; to prevent this the openings of the drains into the courtyard are usually covered with iron gratings. Being checked by this device, the bandicoots make burrows beneath the tiled floors of the courtyards; these are so large that they not infrequently fall in. These collapsed burrows were seen in several of the houses.

These few facts illustrate the extent to which the bandicoots have established themselves among the drains of the city.

Mds. 4, albino bandicoots—

The Madras Museum received from the Municipal rat collecting station two very large white rats which appeared to be albino specimens of *B. indica*.

Mds. 5, *Gunomys sp.*—

Only one small female specimen of the genus *Gunomys* was obtained. The excessively worn condition of the 3rd molar tooth shows that it is an old rat. It measures 142, 108, 27, 18: as compared with an average specimen of *G. bengalensis* it is very small and possesses relatively large feet. It has three pairs of pectoral and three pairs of inguinal teats which do not form a continuous series. In the proportions of the skull it does not differ from many specimens of *G. bengalensis.* The measurements are as follows: l. 38, b. 24, n. 11·5, p.f. 8, mls. 7.

It has been mentioned that another specimen of *Gunomys* was examined by the writer in the Madras Museum; the measurements were not recorded; it was, however, a very much larger rat than the one just described.

Mds. 6, *the Madras Mettad*—

A small adult rat was obtained which from its general appearance was recognised to be a Mettad. It shows at least one important difference from all other *Mus mettada* which have been obtained from other districts. The length of the tail is greater than that of the head and body. The measurements are 105, 112, 22, 17. The lower surface of the tail, though much lighter than the upper surface, is not devoid of pigment. The hair on the tail is shorter than in other Mettads. There is also a trace of a sixth foot-pad on a level with the fifth. The skull is of the typical Mettad form, the antero-posterior curvature and the elongated palatine foramen being conspicuous features. Skull measurements are as follows: l. 30·5, b. 16, n. 13, p.f. 8, mls. 6.

There is no doubt that this rat belongs to a new variety of *Mus mettada*, but because of the great variability found among all races of rats, it does not seem wise to describe this single specimen as the "type" of the Madras Mettad.

We have also received rats from the following places in the Madras Presidency:—

Chingleput, Salem, Gopalpore, Bellary, Madura, Ootacamund, Travancore, Cochin, Tellicherri, Mangalore, Chitur.

Chingleput.

We have received the measurements, skins and skulls of ten rats of the *Mus rattus* type, of one *Gunomys bengalensis* and of a shrew from Lt.-Col. J. C. Marsden.

Cpt. 1—

The ten specimens closely resemble one another; in most of them the colour is yellowish brown, one or two are somewhat reddish. In no case is there any white on the abdomen. The

measurements and specimens show that the Chingleput rats are above the average in size and have relatively short tails. Judging from the measurements it appears that an average example would measure 200, 210, 30, 18.

Cpt. 2—

One large male specimen of *Gunomys bengalensis*, which in colour closely resembles a specimen from Buldana (Berar). The fur is sparse and contains short, slender bristles; it is greyish brown but is much lighter than usual, that of the lower surface being nearly white. The measurements show that it is a very large rat: 265, 177, 30, 20. This specimen, considered together with the specimen found near Madras city (Mds. 5), shows how erroneous it is to speak of the *Gunomys* of Southern India as being of a particular species, the members of which are approximately of a particular size.

Judging from the appearance of the skulls, the measurements of the rats from Chingleput seem somewhat high.

Salem.

Major R. K. Mitter has sent four examples of *Mus rattus*. They are all of the yellowish brown, dark-bellied type. The average of the measurements is approximately 170, 205, 30, 20. They resemble the *Mus rattus* of Madras city and many other places.

Gopalpore (Ganjam).

Mr. R. W. Saldana has sent an example of the common house rat of this place. It is reddish brown above and pure white below. It measures 160, 197, 33, 20. It is a *Mus rattus*.

Madura.

Mr. B. S. Mullyer has sent a bandicoot and a *Mus rattus* from this place. The former resembles the bandicoot of Madras city in every way. The skull measures l. 58, n. 23·5, p.f. 11, mls. 10. The zygomata are broken, so that the greatest breadth cannot be measured. The nasals are 40 per cent. of the total length. The *Mus rattus* is a small specimen of the dark-bellied type such as is common in Madras city.

Bellary.

Mr. S. N. S. Iyer has sent two rats, one of which measures 163, 206, 31, 22, is dark brown and shows no white on the lower surface; the other, an immature rat, has a large patch of white fur on the breast. Both are of the species *Mus rattus*.

Ootacamund.

Major E. M. Illington has sent five measured specimens. One of these is a *Mus rattus*, two are bandicoots and two are mice.

Oot. 1, *Mus rattus*—

The specimen is a large one, measuring 193, 212, 31, 18. The brown element in the fur is of the reddish kind. The throat, chest and belly are covered with pure white fur.

Oot. 2—

This group includes two bandicoots which are different from any others received. Their measurements are—

237	212	50	25
162	125	39	18

The third molar tooth of the larger specimen is well worn, but the smaller specimen is obviously immature. The former differs from the bandicoots of Madras city in being considerably smaller and in possessing a shorter tail; it resembles them in the character of the fur and in the large size of the feet. In general appearance the skull resembles that of *Gunomys varius* of Rangoon. Indeed, the figure of the skull marked Rng. 64 on plate iii will serve as a representation of the skull of the bandicoot from Ootacamund, in size and general proportions, except that the nasal bones of the latter are somewhat longer.

The skull measures l. 48, b. 27, n. 18, p.f. 9·5, mls. 9·5. The nasals are 37·5 % of the total length, so that it is impossible to say which they most resemble, those of the Madras or of the Calcutta bandicoot.

Travancore.

Dr. N. Annandale recently collected seven rats from three separate places in Travancore. Six of them are of the *Mus rattus* type and closely resemble one another, the seventh is an immature *Gunomys.*

Three of the *Mus rattus* were canght in a forest bungalow at Teumalai. One in the Zoological Gardens at Trivandrum and two at Kulatupuza. They are all of the white-bellied type and closely resemble the common rats of Tellicherri (Tli. 3) both in colour and size. Their measurements are—

150	175	30	19
162	213	33	20
171	202	32	21
176	208	30	23
204	197	33	23

The third molars of all are worn.

The small *Gunomys* measures 100, 59, 23, 14, the second molar is unworn, and there is no sign of the third; the specimen is therefore quite immature but it is unlikely that it belongs to the races of *Gunomys* found on the eastern side of Madras, for its fur is nearly black in colour, and the tail, ears and feet are very deeply pigmented. The *Gunomys* found near Madras city and at Chingleput, which

were very different from one another in size, were both of a light greyish brown colour. The skull of this small specimen from Travancore is of the *Gunomys* type.

Cochin.

Captain P. Atal has sent the measurements, skins and skulls of six rats from this place. Two of these are typical examples of *Mus decumanus*. These are the only specimens of *Mus decumanus* which we have received from the Madras Presidency. We have seen that there is strong evidence that this species cannot establish itself in Madras city. In Cochin *Mus decumanus* probably forms an isolated colony, the progenitors of which arrived in Cochin from a ship. There is no harbour at Cochin; sea-going vessels unload cargo by means of shallow draft boats from the shore. Communication between ships' rats and the shore must therefore be possible but of rare occurrence.

Chn. 1—

Type A.—Includes three rats of the *Mus rattus* type which resemble one another closely; the coloured element in the fur is yellowish brown. The under parts are of the dark type, the basal two-thirds of every hair being slate-coloured, the tip being yellowish brown. The measurements are—

167	200	31	25
175	225	37	25
187	212	34	25

Type B.—One specimen differs from the others in colour, though resembling them in size and proportions; in this the coloured element in the fur is a clear reddish brown.

Chn. 2—

Two typical examples of *Mus decumanus* measuring—

225	181	43	18
212	187	47	22

Tellicherri.

Mr. C. Lafrenais has sent the measurements, skins and skulls of forty-eight specimens of *Mus rattus*. The lengths of these are arranged in the diagram, text-fig. 7, which shows that rats of 170 mm. are in the majority, and that the collection contains a specimen of 205 mm. and another of 220. The tail-length varies considerably but is on the average about 120 % of the length of the head and body. The whole collection may be divided into three groups according to the colour of the fur.

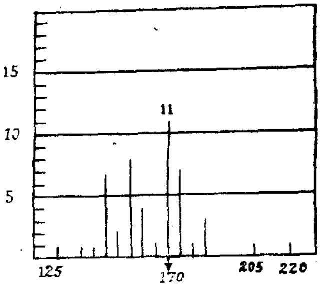

FIG. 7.—Diagram showing the length-frequency of 48 *Mus rattus* from Tellicherri (Lafrenais).

Tci. 1—

This includes two specimens which resemble one another very closely, but can be distiuguished from the others at a glance. In both, the general tone of the upper surface is black, becoming dark brown on the sides and somewhat suddenly fawn-coloured below. The nose, ears and tail are black. The measurements are—

156	206	28	15
125	172	28	18

The smaller specimen is certainly immature. In both, the tail is remarkably long. It is most likely that these two rats were caught in the same house and formed part of the same family group. This assumption explains their resemblance to one another, and the wide difference from the others which they exhibit.

Tci. 2—

Includes eight specimens of the common reddish brown type of *Mus rattus* in which the ventral surface is dark, each hair being slate-grey with a reddish or yellowish fawn-coloured tip.

Tci. 3—

This includes the remaining thirty-eight rats. These cannot be distinguished from those of the former group by an inspection of the upper surfaces of the specimens. They can, however, be distinguished because the throat, breast and abdomen of all of them are covered with pure white fur. Unlike the white-bellied rats of some other districts such as Amritsar, Simla, Rangoon and Calcutta, none of them show a median coloured stripe on the breast. In some the fur of the lower surface is light lemon-yellow rather

than white, and in some the bases of the ventral hairs are light grey. In spite of this it would give a false impression to say that every intermediate stage can readily be found between the members of this and of the former group.

As regards the colour of the upper surface there is much variety; all are of a reddish brown colour but some are of that clear red tiut which recalls the colour of the common English fox or squirrel. In some the black bristles are longer and more conspicuous than in others, so that the middle line of the back is of a much darker tone than the sides. Spines may be plentiful or absent.

Mangalore.

The District Medical Officer has sent thirteen *Mus rattus*, one young bandicoot, and two shrews. The specimens were received in alcohol without measurements.

Mng. 1—

Includes eleven specimens of the dark-bellied type of *Mus rattus*. Measurements of the spirit specimens show that they do not differ in size or proportions from the *Mus rattus* of many other parts of India; the average length is about 175 mm., and the average tail length about 210 mm. Since the collection is in spirit it is difficult to appreciate the colour of the fur; in most of the specimens it appears to be of the common reddish brown tint; spiues and bristles are present in some, less conspicuous iu others.

Mng. 2—

Includes two specimens which differ from those of the former group in being of the pure white-bellied type. These two specimens resemble one another very closely, except that in one of them the soles of the feet are deeply pigmented, while in the other they are light grey.

Mng. 3, *Bandicota sp.*—

This is a remaıkable rat; unfortunately it is not fully grown but the third molar is cut and slightly worn so that it is not far from maturity. It must be regarded as a bandicoot because of the large size of its feet and the characters of the skull; it, however, differs from all other bandicoots met with, in being small and possessing a long tail. The measurements of the spirit specimen are 165, 185, 44, 22. The fur is coarse and bristly as in other bandicoots. The last centimetre of the tail is pure white. The skull closely resembles that of the bandicoot from Ootacamund; it measures l. 44, b. 25·5, n. 16, p.f. 8·5, mls. 10.

Chitur (N. Arcot).

Cr. 1—

We have received from Mr. A. P. Fernandez measurements and skins of fourteen specimens of *Mus rattus*. The measure-

ments show that they vary from 160 to 197 mm. in length, but seven out of the fourteen are between 170 and 180 mm. The average tail measurement of these seven is about 215 mm. In colour they are all of the common reddish brown tint and resemble one another closely. In no specimen is there any white on the abdomen.

If the results obtained from these places in the Madras Presidency be considered together, they show that the races of *Mus rattus* which occur in the south do not differ from those of other parts of India. It is probable that the rats of Madras city are somewhat smaller, and those of Chingleput somewhat larger than usual. But at Tellicherri, Chitur, Travancore and other places the measurements of independent observers show that the size and proportions of the species are about the same as at Amritsar, Allahabad and Calcutta. The average length of the common rat throughout India is about 170 mm.; if large numbers of measurements are made in any place it will be found that there are more rats of nearly this length than of any other length, but that mature rats of 40 mm. less and 40 mm. more than 170 mm. are to be found. Among the rats of the south the colour and quality of the fur is as variable as among those of the north. The most obvious difference is in the fur of the ventral surface, which in some rats is coloured, in others pure white. It seems to the writer to be erroneous to say that there is no specific difference between a white-bellied and a dark-bellied rat. The intermingled distribution of the two kinds makes it almost certain that the dark-bellied form has, from time to time, given rise to the other throughout India; but the opinion that both must therefore be of the same indivisible species seems to be the outcome of a preconceived idea. Until recently, biologists have held it to be impossible for an animal or plant of one kind (variety or species) to give birth to offspring of another kind.

There is little doubt that dark-bellied rats occasionally give rise to white-bellied offspring; therefore the two forms must be of the same elementary species, though the difference in their appearance is obvious. This seems to have been the line of argument usually followed.

To say that the two forms are of one race because every intermediate grade between them could be found by a wide search, is to say nothing against their distinction, for an unbroken series of selected specimens could without difficulty be arranged linking together a small *Mus concolor* of 95 mm. with a large *Mus rattus* of 225 mm. To deny the distinction, because the two forms may interbreed, is to deny that there is any racial distinction among mankind.

It has, apparently, been proved by the experiments of De Vries and confirmed by others, that a plant of one species can produce offspring of different species. The same possibility is perhaps from time to time in all living things. In the light of this discovery we see that the dark-bellied rats and the white-bellied rats are of different elementary species, and that the former are continually giving rise to the latter in many parts of India

The following table shows that white-bellied rats are common in Southern India, and that they occur sporadically :—

Locality.	Number of rats observed.	Dark-bellied rats.	White-bellied rats.
Madras city ..	600	600	0
Chingleput ..	10	10	0
Salem ..	4	4	0
Gopalpore ..	1	0	1
Bellary ..	2	2	0
Ootacamund ..	1	0	1
Travancore ..	7	0	7
Cochin ..	4	4	0
Tellicherri ..	48	10	38
Mangalore ..	13	11	2
Chitur ..	14	14	0

In considering these figures attention must be paid to the relative situation of the places. White-bellied rats only were obtained at Travancore ; dark-bellied rats at Cochin ; both kinds at Tellicherri, the former being in excess ; both at Mangalore, the latter being in excess.

BURMA.

Rangoon.

In February of this year the writer was deputed by the Trustees of the Indian Museum to examine the rats of Rangoon. Owing to the large reward offered by the Municipal authorities of that city, a daily average of about 4,000 rats was then being received at the collecting stations. It was therefore possible within a week to become generally acquainted with the rat population of Rangoon.

The rats were being brought in from a wide area, from rice barns and riverside warehouses, from dwelling-houses, shops and stables in the heart of the city, and detached villages on the outskirts.

The greater number of rats received were brought in dead by the people of the town. Accurate information regarding the place of capture of rats so brought could rarely be obtained. A considerable number, however, were trapped by men in the service of the Municipality. These rats were brought to the collecting stations alive in traps which were labelled with the address of the house or shop from which they had been taken.

Certain features of Rangoon city must be briefly considered, for, as will be seen later, they have an interest bearing on the

nature of the rat population. There are six main thoroughfares in this city lying parallel with the river. They are crossed at right angles by a series of lesser streets which receive numerical designation. In any two of these streets the back walls of the houses are separated by an open space some twelve feet in width, a receptacle for rubbish, which is removed daily. These intervals between the rows of houses are spoken of as the " back drainage spaces."

An estimation of the numbers of the different species received at the collecting stations on six occasions was made. It must be remembered, however, that such estimations can only approximately represent the proportionate numbers of the different species actually present in the city. Doubtless some sorts of rats are to be captured more easily than others. The distribution of the several species must differ in certain parts of the town; for example, the specimens of *Mus decumanus* generally came from riverside buildings.

The groups into which the rats have been here divided are, from the systematist's point of view, of the widest sort. *Mus rattus* and *M. concolor* (the miniature *rattus* of Burma) have for the purposes of this estimation been included in one group, for although this group contains at least two races, numerous individuals were met with which in size were intermediate between the two.

In the group of *Gunomys* are included at least two well-marked races, though many more would be recognised by some systematists. Care was taken to exclude all but adults from the reckoning, for the half-grown *Mus decumanus* is often difficult to distinguish from a young *Nesokia* by superficial examination; the same precaution was necessary in dealing with the *rattus* group.

Occasions.	*Mus rattus* and *concolor.*	*Mus decumanus.*	*Gunomys.*	Mice.	Shrews.
1	49	13	26	24	25
2	245	6	73	116	14
3	29	14	14	0	0
4	122	6	35	21	21
5	144	12	26	97	23
6	66	10	18	25	83
	652	61	192	283	166

Rats were received at the collecting stations at specified times. All the adult rats received at one time were counted on six occasions. Those received on each occasion have been shown separately, as the numbers differ considerably.

The rattus *group.*

After a brief examination of any large number of rats received at a collecting station, it was easy to separate out those belonging to the species *Mus decumanus* and *Gunomys bengalensis*, as well as the mice and shrews. But when these had been set aside, a large number remained which resembled one another in having long pointed snouts, long tails, large ears and six foot pads, one of which was much elongated; that is to say, in possessing those features well known to be characteristic of *Mus rattus*. Among many hundreds examined, however, not one was found which in colour and size together resembled any of the Indian rats.

A large number of measurements of the rats of this group were made, care being taken that only adults were selected, that is to say, those with prominent teats or testes. The teats of any seemingly adult female rat appear in one of three conditions. Firstly, they may be very small and hidden among the fur; secondly, they may be larger and surrounded by sparse fur, so that they are apparent without search; thirdly, they may be even more prominent and at the same time red. The first and second conditions cannot be confused. Female rats with teats in the first condition (very small and hidden among the fur) were considered to be maidens and were rejected, even though they were in some cases larger than those having teats in the second condition. Rats with teats in the second condition were considered to have borne young ones at some time. Those in the third condition were advanced in pregnancy. Only those in the second and third condition were regarded as adults and measured. Examination of the other generative organs confirmed these opinions. Among males those with testes projecting far behind the anus were counted as adults. It has been asserted that the testicles of rats enter the scrotum only during the rutting season. This view does not, however, commend itself, for it has been shown beyond doubt that in India rats breed all the year round, nor does it seem possible at any time to find an old male of the *rattus* group devoid of prominent testicles. For the purposes of these measurements, all rats of whatever size devoid of prominent testes were rejected as immature. It was very necessary to select undoubted adults for measurement. Among the group there seemed to be at least two races, a small dark-bellied race and a large white-bellied race, but immature members of the larger race were sometimes smaller than mature members of the smaller race.

A large number of rats selected with these precautions were measured immediately after death by chloroform. The writer measured sixty of them, selecting equal numbers of the two races. The measurements arranged in series are shown on plate v; although there is some intermingling towards the middle of the series, nearly all those of the dark-bellied type are in the lower half, those of the other type being in the upper half.

In order to illustrate the separation of the two races more fully, 500 adult members of the long-tailed races were subsequently

measured under the supervision of Captain Kelsall, I.M.S. In making these measurements no selection was made; all adult rats if caught alive and if of the long-tailed races were measured until 500 records were obtained. It was expected that by representing the measurements graphically (in the manner described on page 17) a double humped curve would be produced owing to the fact that rats of 120 and of 150 mm. length would be in the majority. This expectation was not realized, for at the time of the experiment the white-bellied rats were not frequently caught, and only sixteen of them were included among the 500. The diagram, however, clearly shows the separation of the two races, for these white-bellied rats are not distributed irregularly among the 500, but are crowded into the upper half of the series. There are, however, two specimens measuring 115 and 120 mm. in length, which are both white-bellied and small, and one specimen measuring as much as 170 mm., which is dark-bellied. The races are none the less separate because of these exceptions, for of 139 rats which measured about 120 mm., only one is white-bellied, while of four which measured 150 mm., all are white-bellied.

Rng. 1, *the small race long known as* Mus concolor—

This rat has been recognised by all writers to be a miniature of the *Mus rattus* type. It forms at least 50 % of the total rats of Rangoon and at least 75 % of the true house rats. The proportions of the race are illustrated in the diagrams, text-fig. 8 and plate v. In length they vary from about 100 to 140 mm., the mean of the race being close to 120 mm. In tail length they are very variable, the tail percentage varying from 100 to 135, with a mean of about 117. The foot is about 20 per cent. of the length. In colour these small rats show the same types as are met with among the larger *Mus rattus* of India. Any thousand of them will show the fulvous, the rufous, the melanotic, and white-bellied varieties. The following types will be described:—

Type A—The brown type.—Rats of this kind resemble in colour the common brown type of *Mus rattus* found throughout India. The hairs of the back are slate-grey in the basal half or two-thirds, their apical portions being of some shade of brown, reddish in some rats, yellowish in others. Those hairs which are longer than the majority are not only grey and brown but have black tips; a few of the longest hairs—the bristles—are black in most of their length. In addition to these are certain hairs which are conspicuous because they are flattened and of a light grey colour; these may have brown or blackish tips; these "spines," as they are technically called, are plentiful in some specimens, scarce or absent in others.

The brown colour produced by this mixture of hairs becomes lighter on the sides and passes gradually into the light brown colour of the ventral surface. The short hairs of this surface are grey in the basal half, brown in the apical half, the brown being often yellowish, sometimes reddish.

Type B—Black variety.—These are not so common, pure black ones making up less than one per cent. of the whole; semi-melanotic specimens are more common. The melanotic and semi-melanotic examples of *Mus concolor* show exactly the same gradations of colour as are exhibited by *Mus rattus* (Hossack [1, page 17]).

Type C—The white-bellied type.—The writer did not himself meet with any adult rats of 120 mm. length of the white-bellied type. The 500 measurements received from Captain Kelsall show, however, that they are to be found; each measurement was accompanied by a statement that it was of a rat which was sexually mature. These small white-bellied rats might be considered as exceptionally small members of the race next to be described.

The figures beneath the horizontal line in text-fig. 8, which show the numbers of white-bellied rats of each measurement which are

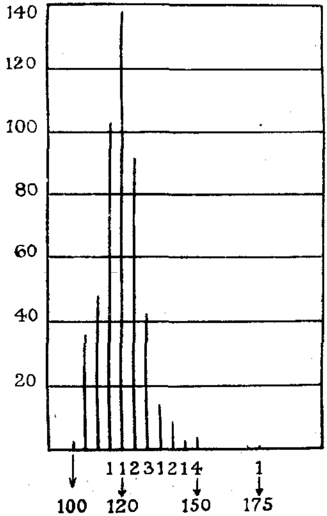

FIG. 8.—Diagram showing the length-frequency of 500 *Mus concolor* and white-bellied *Mus rattus* from Rangoon (Kelsall).

present, seem to indicate that some of them, for example the one measuring 115 mm., should be regarded as white-bellied *Mus concolor*. A point of distinction is always present in the case of females, for no exception was found to the rule that the teats in *Mus concolor* were eight in number ($\frac{2}{2}$). The dark-bellied rat shown as measuring 170 mm. length was probably a recent

importation of the common *Mus rattus* type. There is one interesting white-bellied rat measuring 147, 153, 30, 18 which has teats of the *Mus concolor* formula ($\frac{2}{2}$).

Measurements of five chance-taken skulls of adult Mus concolor.

Length of rat.	Skull length.	Breadth.	Nasals.	Pal. for.	Molars.
108	27·5	15	10·5	6	5
	100	54·9	37·4	..	..
110	28	15	11	6	5
	100	53·6	39·2	..	..
104	26	13	10	5·5	4·5
	100	50	38·4	..	..
123	28	14·5	10·5	6	5
	100	51·8	37·5	..	..
117	28	14	10·5	6	5
	100	50	37·5	..	..

These skulls show no difference in their proportions from the *Mus rattus* type.

These three divisions A, B and C of Rng. 1 might be more finely subdivided. A large number of mixed *concolor* taken from all parts of the city could be arranged so as to show "intermediates" not only between the subdivisions but between the divisions. In spite of this, divisions and subdivisions are definite entities, for rats found together in one house are nearly always of the same type. Melanotic or semi-melanotic *concolors* are comparatively rare, but they are caught, not singly, but three or four at a time.

Rng. 2—

A race of the *Mus rattus* type, the members of which are of medium size, have white under parts and comparatively short tails of uniform dark colour; the females have teats almost invariably $\frac{3}{3}$.

The peculiarities of this race are illustrated in the diagram (plate v). The mean length of the race is about 145 mm. The tail length averages about 105 per cent. of the length. The zigzag line *Ct.* shows that the percentage is lower in this race than in *concolor*. The teats were counted in eight mature females; in six of them they were $\frac{3}{3}$, in one $\frac{2}{3}$, in another $\frac{2}{2}$. As regards colour they all agree in possessing white under parts sharply defined from the brown upper parts. In most of them the white is pure, but grey median breast stripes of varying width and length are not uncommon. In a few specimens all the ventral hairs have light grey bases and white tips. As regards colour of the upper parts, perhaps the commonest type is a dull greyish brown almost exactly like a

typical *Mus decumanus*. There is no darkening in the middle line due to excess of black bristles.

There are many other types; some few are as red as any that we have obtained from any part of India, that is to say, as red as an English squirrel. Numerous intermediate types occur. The soles of the feet are unpigmented, light grey, or mottled, the upper surface is covered with white hairs, sometimes with light brown hairs.

This description is based on an examination of some hundreds collected from different parts of the town. The rats from any one house, however, resemble one another very closely as a rule. Together they form a definite race composed of innumerable "family groups" which are in some cases as distinct as the species of modern writers.

It is difficult to find a suitable name for this race. Several white-bellied rats with unicoloured tails have received specific names in the Oriental region, especially from countries south of Burma. Among these *Mus jalorensis*, judging from the description, comes nearest to an average member of the Rangoon race. The feet of the "type" *Mus jalorensis* are described as dark brown above with blackish soles. Individuals with deeply pigmented feet are rare among the Rangoon race. It is most improbable that one chance-taken specimen from Rangoon would closely resemble the type of *M. jalorensis*. It is, however, certain, in my opinion, that if the "type" of the rat of Jalor were sent to Rangoon, many individuals exactly agreeing with it could be selected from any thousand of the rats of that town. This does not justify the appellation of the name to this heterogeneous race, for it seems equally certain that specimens agreeing exactly with some other "types" of established species could be selected from among ten thousand of the Rangoon race. A similar selection might be made in Singapore or other large towns.

In the proportions of the skull the race does not differ from the *Mus rattus* type so far as can be shown by measurements of five chance-taken adults.

Length of rat.	Skull length.	Breadth.	Nasals.	Pal. for.	Molars.
140	33·5	16·5	12	7	6·5
	100	50	35·5	..	..
151	34·5	18·5	13	7	7
	100	53·5	37·6	..	..
153	35·5	18	14	7·5	7
	100	50·7	39·4	..	..
163	36	18·5	14	7	7
	100	50	38·8	..	..
170	37	18·5	14	8	7·5
	100	50	37·8	..	..

The tails of these rats are of a dark greyish brown colour, of exactly the same shade above and below.

Rng. 3—

One young specimen was obtained which measures 113, 97 (tip broken), 28, 16; this exactly resembles many of the immature members of the group Rng. 2, but differs from them in that the under side of the tail is completely devoid of pigment. In this respect, therefore, it resembles *Mus jerdoni, niveiventer, vicerex, bukit, rapit*, etc. It is regarded as a sport born from one of the race Rng. 2, for it is unique among many hundreds of rats which it otherwise resembles, and it is too young to be an importation. Its immaturity is shown by its small size and large feet, also by the fact that the third molar is not cut.

Rng. 4, Gunomys varius—

Rats of this species were called "bandicoots" by the officials in charge of the rat-catching operations. This name was a good one, for, besides closely resembling bandicoots in the bristly nature of their fur, these rats have skulls which are hardly to be distinguished from those of small specimens of *Bandicota nemorivaga*, but considerably different from *Gunomys bengalensis* (plate iii). In general appearance, however, they differ from bandicoots in being less in length but relatively stouter, and in having shorter tails and shorter feet, peculiarities which belong to the *Gunomys* type.

Probably not less than 10 % of the rats of Rangoon belong to this species. Estimations made at the collecting station may show figures somewhat less than this, but like the bandicoots of Madras city this outdoor rat must be difficult to capture. It is too large to enter cage traps with ease. Questions as to the place and mode of their capture almost always met with the same response, "killed with a stick in a back drainage space."

It seems that this rat has never been noticed in Burma before although it has been long known from countries further south. It can be traced back in scientific literature as far as 1824, when Horsfield discovered it in Java and published a long account of it with an excellent engraving [14]. It was named *Mus setifer* by its discoverer, who considered it akin to *Mus giganteus*, the name which used to be applied to the Indian bandicoots. Cantor recorded it under the same name from Penang [15], and held the same view of its affinities. Blanford, in the *Fauna of British India*, 1891, regards *Mus setifer* as a doubtful synonym of *Nesokia* (*i.e.*, *Bandicota*) *nemorivaga*, but he mentions that the Burmese form of *Nesokia bengalensis* is larger than the Bengal form. This statement may have arisen from the presence of *Gunomys varius* in Burma.

In 1907 this rat appeared as *Gunomys varius*, sp. nov. The author who gave it this name regarded it as the Malayan representative of *Gunomys bengalensis*. He states clearly, "This is *Mus setifer*, Horsfield." The species is a most interesting one,

for in the relative proportions of body, tail and feet it is of the *Gunomys* type, but in its large size, the character of its fur and in the proportions of its skull it approaches the bandicoot type. It will be shown, firstly, that this common Rangoon rat is *Gunomys varius*; secondly, that it is more or less intermediate between *Gunomys* and *Bandicota*.

Although large numbers of these rats were examined daily, only four selected specimens were taken to Calcutta. These are all adults, they include large (A), medium (B) and small (C) specimens, and one colour-variety of a light buff colour (D). The large specimen happens to be of the same size as the "type" of *Gunomys varius*.

	Length.	Tail.	Hind foot.	Ear.
Type of *G. varius* (*Ann. Mag. N. H.*, 1907, p. 205).	266 100	197 74	40 15	19 ..
A	265 100	208 80	39 14·3	22 ..
B	230 100	180 78	36 16	20 ..
C	205 100	165 80	35 17	20 ..
D (buff variety)	260 100	195 75	49 19	22 ..
Average percentage in *Gunomys bengalensis*.	100	80	17	.. ..
Ditto in *Bandicota nemorivaga*.	100	95	19	..

These figures show that the rat we are dealing with is *Gunomys varius*, and that in its proportions it is more nearly a *Gunomys* than a bandicoot.

In the character of the fur our specimens exactly agree with the description of the "type." The upper surface shows a mixture of black and creamy buff-coloured hairs, with a large number of long black bristles, the tail is covered with relatively long hair. In the proportions of the skull the similarities to the type are not less close.

	Condylo-basal.	Greatest breadth.	Nasals.	Mol. alv.	Pal. f.	Dia.	Frontal height.
G. varius type	48 100	26·7 55	16 33·3	8·5 ..	10 ..	16·3 ..	15·5 ..
A	50·5 100	29 54·5	16·5 32·7	9 ..	11 ..	17 ..	16 ..
B	47·5 100	broken	16 33·6	8 ..	9·5 ..	15 ..	15 ..
C	44 100	25 56·8	14·5 33	8 ..	9·5 ..	14 ..	13·5 ..
D	53 100	29 54·4	17 32	10 ..	10·5 ..	17 ..	15·5 ..
Bandicota nemorivaga.	100	54	36·5	..	..	..	..
Gunomys bengalensis.	100	60	29	..	..	..	..

These figures also show that our specimens belong to the species *Gunomys varius*, but that this species resembles *Bandicota* in the proportions of the skull. The similarity is also shown in plate iii.

Rng. 5—

A sport from *Gunomys varius*, differing from the type in being of a light buff colour and in possessing much larger feet.

Rats of this type were occasionally received at one of the collecting stations. The writer obtained one adult specimen and saw two young ones, survivors from a litter of five. The measurements of the adult are given under Rng. 4, specimen D. It generally resembles *Gunomys varius* but every hair on its body is of a light buff colour. The abnormal size of the hind feet is also very noticeable; in an equal sized or slightly larger specimen the foot is 38 mm., in the buff specimen it is no less than 49 mm. The two young ones also had extraordinarily large feet, but relative proportion of the feet is usually somewhat enhanced in young rats.

These buff-coloured rats are not regarded as an established es but rather as a sport from *Gunomys varius* which has met

with some slight temporary success in the struggle for existence owing perhaps to their being prepotent and of exceptional fertility. Their colour must be a disadvantage to them, rendering them conspicuous.

This opinion is favoured by the fact that among some thousands of the smaller *Gunomys bengalensis* which were observed in Calcutta by Dr. Hossack were two specimens which were of exactly the same light buff colour; they do not, however, possess exceptionally large feet. These are evidently sports from *Gunomys bengalensis*.

Rng. 6—

A tailless sport from *Gunomys varius.*

This rat was preserved as a pet at one of the collecting stations. The official in charge told me that he had reared it because of its strange abnormality. It showed no trace of the lost appendage, and even when quite young no scar was visible. It was evidently a congenital peculiarity. Such a sport would have little chance of becoming established, as it would probably be shunned by other rats.

Rng. 7, *Gunomys bengalensis*—

Rats of this species make up about 15 % of the rat population of Rangoon. At first sight a collection of these rats appears to exactly resemble a collection of the same species made in Calcutta. The proportions of body and skull are the same in the two cases. They show the same range of variation. The first four adults which came to hand were measured; they were part of a large batch which were captured in a stable.

Length.	Tail length.	Hind foot.	Ear.
162	135 (83 %)	35	19
161	129 (80 %)	34	20
169	124 (70 %)	36	20
169	119 (73 %)	34	21

In colour these four were as closely alike as in size, but it would not be accurate to say that they represented the type of *Gunomys bengalensis* present in Rangoon. They may be referred to as type A of Rng. 7.

Another specimen was selected—type B. This measures 184, 150, 35, 30. The fur of this rat contains much longer bristles and is of a dark reddish brown colour. Rats of type A have dull greyish brown fur and short bristles.

There was another type—C—of which three specimens were obtained on two occasions, but all three were from a village named Dalah on the outskirts of the city. It happens that these three are of nearly the same size as those of type A.

Length.	Tail length.	Hind foot.	Ear.
167	136 (81 %)	32	17
163	137 (84 %)	34	18
158	140 (82 %)	34	20

They differ from the others in that the fur is nearly devoid of bristles and is soft and silky to the touch. They also seem to have broader skulls, but more material would be necessary before this important point could be proved. It would be possible to enumerate many other types. These, however, were the most distiuct that were met with during the few days of my visit.

After describing these types it is perhaps necessary to explain the statement that the species *G. bengalensis* is common to Rangoon and Calcutta. If two chance-taken specimens, one from each place, be laid side by side, it is most unlikely that they would resemble one another closely in colour, size, or proportions, yet a single specimen from one place conld be very closely matched by searching among large numbers of specimens from the other place. The rats of type C, however, were not quite like any of the Calcutta specimens; they were more like the soft-furred Punjab type. In my opinion, the types A, B and C, which are merely three of a large number which could be made from the mole-rats of Rangoon, show differences at least as great as those which are used to separate "species" at the present day. By searching among a collection of many thousands taken from all parts of the city there is no doubt that every gradatiou between each type could be found. The types are none the less separate because of this, however. If, for example, twenty mole-rats are caught together in one stable or warehouse, they will almost always be of the same type, and only show slight individual variations amongst themselves.

Rng. 8—

A family group or localized race of *Gunomys bengalensis* characterised by the pure black colour of its members.

These are considered separately as, owing to their black colour, they were remarkably different from all others of the species. Individuals intermediate between the black and the normal greyish brown forms were not met with. The occurrence of this group is of such interest that it will be described in detail. It shows the extent to which mole-rats have associated themselves with man.

It has been recently proved that both in Calcutta and Dacca these rats occur in large numbers not only in stables and out-houses but also in shops and dwelling-houses. Some doubt perhaps still remains as to whether this occurrence may not be due to a temporary and fluctuating migration of these rats, which have long been known as dwellers in the fields. In Rangoon, however, the evidence was clear that they live continually and propagate themselves in dwelling-houses in the heart of the city.

A case of plague having occurred in a certain house (No. 65 Maung Khyine Street), a number of traps were set in that house by the Municipal rat-catchers; on the following day these traps were brought to the collecting station containing five pure black *Gunomys*. Traps were set in adjacent houses, and on the next night from house No. 65 one other was obtained, and from the adjacent house, No. 66, three precisely similar rats were obtained. Again on the following night one more was obtained from house No. 66. After this no more were obtained.

The writer visited these houses and noticed where the traps were placed. Both houses were built principally of wood, and consisted of upper and lower rooms, the former being closed and unoccupied. Number 65 was a tailor's shop and dwelling-house. Number 66 was a laundry. The houses were divided by a double partition of thin planking separated by a narrow space. The floors were tiled. In front the houses opened directly on to the street, behind on to the "back drainage space."

The ten rats taken in these two houses could be recognised at a glance by their pure black colour from any other *Gunomys* taken from other parts of the city. They must have been closely related as a family to one another. It seems much more likely that they had been bred where they were found, than that they had migrated together as a family from the fields. If the more probable view is the correct one, it can be asserted that these *Gunomys* rear their young within the houses in the manner of house rats. The houses in which they were found had no adjacent garden or waste space available for the making of burrows.

The "back drainage space" was, owing to the daily cleansing, as unsuitable for the rearing of a field rat's family as the busy street itself. No one who has seen traps from houses brought in daily, containing *Gunomys*, mature, immature and pregnant, can doubt that these rats, which are perhaps the commonest field rats in India, have become permanent parasites of man within some of the larger towns.

Of these ten rats, four were brought to Calcutta. Their measurements are as follows :—

Length.	Tail length.	Hind foot.	Ear.
203	170 (83 %)	36	21
193	158 (81·8 %)	38	21
177	141 (80 %)	35	20
158	130 (82 %)	32	20

Only the first two were fully mature.

The figures show that these black rats resemble one another not only in their colour but also in being well above the average in length, and very closely alike in their tail index. (Hossack gives for fifty mixed *Gunomys bengalensis* in Calcutta range in length from 150—205, with an average of 182. Tail index range from 69—94, average 81·1.)

The skull proportions of these black rats agree closely with one another and differ considerably from the average of the species.

Length.	Breadth.	Nasals.	Pal. for.	Molars.	Remarks.
44·5	25·5	14	9	8	Mature.
100	57·3	31·4	..	..	
43	25	13·5	9	8	Mature.
100	58	31·4	..	..	Young.
41	24	13	..	..	
100	58·5	31·7	9	..	

For twenty skulls of *G. bengalensis* from Calcutta, Hossack gives the following :—

Range of length	.. ..	37 to 44	average	39·6
$\frac{\text{Breadth}}{\text{Length}}$	.. ..	58·2 to 63·3.	,,	59·8
$\frac{\text{Nasal length}}{\text{Length}}$	.. ..	28·2 to 31·8	,,	29·3

Thus as regards breadth two of the three are less than the least of the twenty Calcutta skulls. As regards length of nasals all three are very close to the highest value found among the Calcutta specimens.

The members of this group have therefore no less than four peculiarities: blackness of fur, increased size, narrowness of skull, and increased length of nasals.[1]

It seems that the last three of these peculiarities are elsewhere associated, for under the heading " Buldana " will be found a description of a local race of *Gunomys* which shows the same three peculiarities. The bandicoots also illustrate this correlation.

[1] **Two more of these black mole-rats have been recently obtained from Rangoon; they show the same peculiarities.**

Rng. 8 *A*—

A few days after the capture of these ten melanotic *Gunomys*, a man brought in three somewhat similar rats from another part of the town. These were also pure black specimens of *G. bengalensis*, but they were different from the others in that the muzzle, and to some extent the ears, were scantily pigmented. These parts were consequently of a livid pinkish colour, and gave to their possessors an appearance remarkably different from the others, the noses aud ears of which were very deeply pigmented. It was not possible to trace their exact habitat; being somewhat decomposed they were not kept.

It seems likely that these two melanotic varieties had arisen quite independently of one another, although in the same town.

UPPER BURMA.

The rats of Upper Burma resemble the rats of Rangoon so far as has been ascertained. The common dark-bellied *Mus rattus* of India is not common in Burma. In place of it we find the small *Mus concolor* and a white-bellied race of *Mus rattus* the members of which, in Rangoon and perhaps throughout Burma, are on the average smaller and have shorter tails than *Mus rattus* of the Indian Peninsula.

Myitkyina (Bhamo).

We have received, through Dr. L. Fink, a number of specimens from Kamaung, Mogaung, Mankin and Myitkyina. The first specimen sent was a typical *Mus decumanus*. It has been stated that China is probably the home of this wandering species,: since Bhamo is close to the borders of China, other specimens were awaited with interest; when received they were found to consist of twenty typical *Mus concolor*, one other immature *Mus decumanus*, two white-bellied *Mus rattus*, and one dark-bellied *Mus rattus* of normal size. The progenitors of the *M. decumanus* probably arrived by the steamboats which ply between Rangoon and Bhamo. The examples of *Mus concolor* are indistinguishable from those of Rangoon; some of them have white-tipped tails; of four specimens from Kamaung, sent by Captain Gandoin, two show this peculiar character.

Mr. Hefferman has sent two *Mus concolor* from Lower Chindwin; these measure 122 and 131 mm. in length; one of them has a white-tipped tail. This character seems specially common among *Mus concolor* in Upper Burma. It has been previously mentioned that it occurs sporadically and more rarely in India among the genera *Mus*, *Gunomys* and *Bandicota*.

Captain Gandoin has sent a white-bellied *Mus rattus* from Yamethin; it measures 150, 200, 26, 20. We have also received a large number of measurements from Mandalay, but in the absence of specimens little can be said in regard to them; it is probable that *Gunomys varius* occurs there, and that *Mus concolor* is common.

WEST AUSTRALIA.

We have received an interesting collection of rats from Mr. T. H. Lovegrove of the Department of Public Health in Perth. These were all caught in the port of Freemantle either from the wharves or ships. The collection contains eight *Mus rattus* and two *Mus decumanus*. The two latter and one black *Mus rattus* are labelled "Freemantle wharves." The other seven *Mus rattus* are labelled "S. S. *Sultan.*" They were probably taken during one of the periodical destructions of vermin which are sometimes carried out on ships. In regard to *Mus decumanus* nothing need be said; they are quite indistinguishable from others of the species obtained in Calcutta and Rangoon. The seven rats from the ship are most interesting. Among them are to be found examples of the three chief kinds met with in India. Four of them are black, three are brown and indistinguishable from one another as to their upper surface, but two of them are white-bellied and the other is brown-bellied. The three kinds are distinguishable from one another at a glance, but each is indistinguishable from the corresponding kind found in India, at a port such as Bombay, or an inland town such as Cawnpore. *Surely it cannot be supposed that these three kinds have each arisen separately and subsequently become associated with one another so as to have distributed themselves widely in the intermingled state in which they are found.*

The measurements of the seven rats are interesting. They seem somewhat higher than might be expected from the appearance of the specimens, at the same time the tails seem somewhat short. The measurements have probably been taken from the first ring of the tail and not from the anus; if so, 10 mm. should be subtracted from the lengths and added to the tail lengths in order to bring the measurements into line with our others. The measurements are all by the same hand and so may be safely compared *inter se*. As has been noticed both at Cawnpore and Calcutta, the black rats are smaller than the brown ones.

Length.	Tail length.	Colour.	Remarks.
150	190	Black	Immature.
193	190 br.	,,	Mature.
195	230	,,	,,
210	225	,,	,,
215	230	Brown	Brown-bellied.
218	230	,,	White-bellied.
220	235	,,	,,

We have also obtained a specimen of the Australian rat ***Hydromys fulginosus***.

BOMBAY.

The rats of Bombay have been fully dealt with by Captain Liston and the workers of the Plague Commission. Judging from several specimens leut by the Bombay Natural History Society, I conclude that the three kinds of *Mus rattus*, the black, the brown and the brown white-bellied, are commonly found there.

In concluding this systematic account I must express my thanks to all those gentlemen who have contributed measurements and specimens. Thanks are especially due to Captain G. I. Davys, I.M.S., who, aided by his assistant, H. A. Khazan Chand, has sent over one thousand. The extent of their work can only be properly appreciated by any one who has measured and skinned even twenty rats in a hot climate.

Although I have not always agreed with Dr. Hossack's conclusions, I have never been able to dispute his observations; and I must repeat my thanks to him for introducing me to the subject, and for establishing the precedent of examining rats in large numbers.

Finally, my thanks are especially due to Dr. Annandale not only for the interest he has shown in the work day by day but for his steadying influence among the perplexity of sports and races, as well as for the liberal way in which, as Editor of the *Indian Museum Records*, he has allowed me to express views which are not quite in accordance with museum traditions.

APPENDIX I.

THE BEARING OF THE ENQUIRY ON PLAGUE DISSEMINATION.

Since it has been recognised that rats are important factors in the dissemination of plague, the attention of many has been turned towards these rodents. In consequence it became evident that we knew little of the distribution of their several races in India, and that some of the hitherto accepted statements in regard to them must be looked upon doubtfully. It was shown that mole-rats, which were considered solely as dwellers in the fields, could, in some circumstances, become intimately associated with man, while in other circumstances house rats might establish themselves in the fields. Doubt was felt as to the extent to which the wandering grey rat (*Mus decumanus*) prevailed in India. It was shown that the races of rats infesting Calcutta and Bombay were remarkably different from one another, so that it became desirable to compare them with those of other ports. The present enquiry is an attempt to throw light on some of these questions.

The extermination of rats has been largely carried out in many districts in India as a means of directly diminishing plague mortality. Such measures are perhaps partly of an experimental nature; the question of their efficacy cannot be discussed here,—

it is one for sanitary science to deal with. It was clear, however, that this attempted rat extermination provided an opportunity of gaining information regarding the distribution of the various kinds of rats throughout the country, since large numbers of them could be collected from different localities and compared; from this comparison information of direct or indirect practical importance might be gained. It has been kept well in view that to obtain such information was the purpose of the present inquiry. Although the practical value of the information may not seem great, it is hoped that the facts themselves will be of suggestive value to those more acquainted with the ætiology of plague than the writer.

A COMPARISON BETWEEN RATS FOUND IN THE PORTS OF BOMBAY, CALCUTTA, MADRAS AND RANGOON.

This question is of importance, for as a rule the sea-ports are the doors by which the infection of plague enters a country. In all probability plague entered the Bombay Presidency and Upper India by the port of Bombay, and it certainly entered Burma through Rangoon.

In comparing the rodents of the four great ports, one important fact stands out. *Mus decumanus* is common both in Bombay and Calcutta; it is not uncommon in Rangoon, but it is absent from the city of Madras. There must be a definite cause to account for this. There is another peculiarity in the rodents of Madras. The bandicoot is very rarely found in Bombay. It is uncommon in Calcutta, where it is occasionally found burrowing near the numerous tanks of that city. It is absent from Rangoon; a smaller sort of bandicoot is common there. In Madras, however, the large bandicoot is so common that the populace can kill as many as one hundred of them daily, although it is too large to enter traps and has to be killed by blows from sticks. The Madras bandicoot is an outdoor rat, a dweller in drains and outhouses, having a total length of about two feet; it would not be tolerated in the houses, where it could not move without detection. Its mode of life is therefore essentially the same as that of *Mus decumanus.* The rodent fauna of Madras is therefore peculiar in two ways, in the presence of the bandicoot and in the absence of *Mus decumanus.* These two peculiarities are obviously associated with one another. The bandicoot occupies exactly the same position among the rats of Madras that *Mus decumanus* occupies among the rats of Bombay and Calcutta, and since the bandicoot is much more powerful even than *Mus decumanus*, there is no place for this latter rat in Madras unless it can change its habits entirely. A consideration of the rodents of Rangoon lends support to this view. In Rangoon *Mus decumanus* is to be found, but it is much less common than in Bombay or Calcutta; this may be due to the presence of the small bandicoot, *Gunomys varius*, which is, like *Mus decumanus*, an essentially outdoor rat, and must compete with this latter species. Since the

Rangoon bandicoot is much smaller than the Madras one, the grey rat can exist though it does not flourish as in Bombay and Calcutta.

In the last report of the Plague Commission it was shown that *Mus decumanus* was the species which in Bombay had a preponderating influence in plague dissemination. Certain conclusions may be quoted from the report (*Journal of Hygiene*, vol. vii, No. 6).

"With regard to the epizootic amongst the rats, the following conclusions may be formulated :—

(1) *Mus decumanus* and *Mus rattus* are equally susceptible to plague.
(2) The incidence of plague is twice as great on the *decumanus* population as on the *rattus* population.
(3) *Mus decumanus* is the species which is chiefly responsible for the diffusion of plague amongst the rats throughout Bombay city.
(4) The *decumanus* epizootic precedes the *rattus* epizootic by a mean interval of about ten days.
(5) The *rattus* epizootic is directly attributable to the *decumanus* epizootic.
(6) Plague persists in the rats in Bombay city during the off season. This persistence is due chiefly to *Mus decumanus*."

The conflicting natures of the first and second statements are reconciled and explained by the fact that *Mus decumanus*, on an average, harbours twice as many fleas as *Mus rattus*.

It seems, therefore, that *Mus decumanus* is an important factor in the sanitation of a port. After reading the conclusions quoted above, anyone must be struck with the coincidence that Madras, the one port which does not harbour *Mus decumanus*, is the one port which has never been seriously infected with plague. That Madras is not wholly protected by its climate is shown by the fact that there has been at least one outbreak of plague, temporary but severe, on the outskirts of the city.[1] On the other hand, it must be remembered that plague persists to a grievous extent among certain provinces of India into which *Mus decumanus* seldom or never penetrates.

The insanitary effect of *decumanus* as a port rat can be seen from another point of view. In a port where this rat is firmly established, there must be much more interchange between ship and shore rats than in a port like Madras, where the large bandicoot alone is the common outdoor rat, for the bandicoots probably never enter ships, whereas *Mus decumanus* is perhaps the commonest of all sea-going rats. It has not yet been thoroughly ascertained to what extent the different species of rats infest ships plying in tropical seas. Judging from very scanty observations and inquiries it appears that any one ship harbours only one species at a time —sometimes *Mus rattus*, sometimes *decumanus*. A thorough investigation of this subject would be interesting and important.

[1] If, as appears, the bandicoots themselves are particularly susceptible to plague, the absence of *Mus decumanus* from Madras is of no significance.

THE INLAND DISTRIBUTION OF *Mus decumanus.*

It appears that, notwithstanding many statements to the contrary, *Mus decumanus* does not occur in India except in seaports. This statement may be proved, in the future, to be erroneous, but all the evidence of this inquiry is in favour of the view that the grey rat has not established itself in any part of the interior of the peninsula. Certain writers relate how this rat passes up the great rivers by means of country boats to establish itself in riverside towns, and it has even been stated that it is fast replacing the indigenous rat in India. Allahabad and Cawnpore are situated on the banks of the Ganges at points where the river is navigable for country boats; in both of these cities many thousands of rats were caught, but not one *Mus decumanus* was among them. It is impossible that they could have been overlooked, for in both places the officers in charge of the operations paid great attention to the question of the species caught, and *Mus decumanus* can be easily distinguished from *Mus rattus.*

OTHER OBSERVATIONS BEARING ON THE QUESTION OF PLAGUE DISSEMINATION.

It has been sufficiently shown that the species *Mus rattus* is the common house rat throughout the whole peninsula of India, that it occurs intimately associated with man in every place (with the single exception of Quetta) in which it has been looked for. The fact of its absence from Quetta is doubtful and requires confirmation (see page 33). If it could be shown that this species is rare in or absent from Quetta, the cause of its absence should be carefully sought for as it might have a direct bearing on plague prevention. It has been shown that, in any town, rats of this species show individual differences from one another, and that in certain places they show slight racial differences; so that although it is often impossible to say whether a particular rat was native to Tellicherri or Amritsar, it would be easy to identify a group of fifty rats from either place. In certain instances, however, individuals could be identified. For example, single rats from Kashmir, Amritsar and Katmandu could be almost always identified at a glance. In spite of this the fact remains that any of a small collection of house rats from Adelaide in Australia can be "matched" exactly, by searching among large numbers of the rats of Calcutta, Bombay, Cawnpore or many other large towns on the plains of India. In colour they can be matched as closely as two threads in the same skein of coloured silk. In proportions of body and skull the similarities are not less than those indicated by this comparison. Therefore it seems that there is no reason why a rat should not wander freely, in or out of the country, and intermingle with the rats of places far removed from its own birth-place, without being recognised as an interloper. However, all the evidence that can be obtained shows that rats do not wander freely, that they rarely move from village to village of an Indian rural district, and that

they even confine themselves to particular houses or groups of houses, and are much given to breeding within the family circle.

To obtain sure evidence about such a question is a matter of some difficulty. It might be obtained experimentally by means of marked rats. Fortunately cases have occurred in which Nature has herself provided the mark. Captain Davys has contributed a good example from the Amritsar district, aud pointed out its significance. Among a mixed collection of *Mus rattus* from any large Indian town there is often a small number of white-bellied ones. Among the large number of rats which we received from the Punjab was a small sprinkling of such forms, and it was definitely ascertained by the sender that out of sixty-nine villages, in which rats had been collected, only three provided these white-bellied forms, and that they made up about ten per cent. of the total rats of those villages. Whether we regard the white-bellied forms as a separate race or not, there is clearly not much intercourse between the rats of those villages.

Two other cases have been already described which show conclusively that a group of rats may identify itself with certain adjoining houses. The first of these is the case in which ten black mole-rats were caught in two adjoining houses in Rangoon during three nights, and no other kind of rat was caught at the time in those houses, although black mole-rats are very rare indeed. This shows that a " family group " may establish itself within very narrow limits, keeping without those limits all others who are not of the group. A precisely similar case was recorded from Naini Tal where the house rats found on a part of Ayapata Hill could always be distinguished from those which dwelt at either end of the lake, although the three places were separated by less than a mile. It may be objected that these examples do not constitute fair evidence in favour of the view that the rats of one species in a town do not freely intermingle, because in these cases the rats have been marked off by their peculiarities from the majority, and held themselves aloof.

While watching large numbers of rats brought in by townsfolk, the observer is compelled to recognise that the rats of any one species are split up into a great number of " family groups " or clans, each with its own limited domain. If, for example, at a collecting station rats of the long-tailed kind are superficially examined and set aside, the accumulation, which consists perhaps of some hundreds of individuals, has a truly heterogeneous appearance; some few of its constituents are black or nearly so, a few are pure white below, others are white below with a grey breast stripe. Among them there is much variation in size. The length of one may be 150 mm., the length of another 200 mm., both being obviously adult. Tail length will vary from 105 % to 135 % of length. In respect to length or tail length, the rats can be laid out side by side in an unbroken series, the mediocre in both respects being in the majority. In respect to colour it is much more difficult to arrange them in an unbroken series. The collection will perhaps

contain one or two pure black rats and four or five others of a blackish tone which show a variable mixture of brown hairs; but one cannot find, when dealing with hundreds, every shade between a black rat and a light brown one. Similarly, one cannot arrange a satisfactory series between the white-bellied type and the commoner brown-bellied type, although some of the former have coloured breast stripes of variable breadth and some of the latter are very light in colour.

The collection is truly heterogeneous in appearance, although, in a broad sense, it consists of animals of one species. The individuals composing it have been brought in batches of two or three together, by the townsfolk. It is often noticeable that the individuals of any one batch very closely resemble one another. Thus the melanotic and semi-melanotic rats would probably all be brought in by one man. Another man would bring unusually large rats, a third would bring four or five white-bellied rats with relatively short tails, some with breast stripes, others without. The members of the separate batches often show a likeness to one another. This can only be explained by the fact that the members of each batch were usually taken together from a single house, the likeness being a true "family likeness." By the word "family" is meant a small localized group whose members are given to inbreeding. These observations point to the conclusion that the rats of one species in a town are divided into a number of groups which hold little intercourse with one another.

Experimental evidence of a more certain nature could be obtained by successively capturing, marking, releasing, and after an interval recapturing a large number of rats. It might be predicted that the recapture would take place in all cases in the same house that the capture and marking was effected. Such experiments could probably be carried out without much difficulty. The rats should be caught in a trap, anæsthetized lightly by placing the traps in a closed box containing chloroform, and removed from the trap while unconscious. They might be marked by branding the tail or piercing the ears. Recovery from chloroform in rats takes place with certainty, and often with most disconcerting quickness. The accidental scars which are present on so many rats might lead to some confusion, but a system of marking by metal rings and number plates would probably prove unsatisfactory. To recapture the rats it would be probably necessary to use spring jaw traps of which there are many effective patterns. Such experiments would give direct evidence of the movements of rats in a town or village which would be of value in any consideration of the means of plague dissemination.

APPENDIX II.

QUESTIONS OF BIOLOGICAL INTEREST.

The Government's measures against rats have afforded a unique opportunity of studying large numbers of closely related

and widely distributed animals. During the enquiry several matters of general biological interest have made themselves felt.

The chief interest lies in the large number of sports which have been met with; that is to say of individuals which differ widely in some character or characters from the race in community with which they were found, although otherwise closely resembling that race. The differences which characterise these sports are of colour for the most part; they are, however, in some cases, of a wider degree than the slight differences which are used at the present day to separate species. It is unusual to examine any race of animals in large numbers without meeting with sports both of colour and of form, but the peculiar interest of this enquiry lies in the several instances in which such sports have appeared in groups. Some of them have been met with singly, others as pairs caught together in the same trap, others in "litters" all the members of which agree in differing from the normal race in the same way and nearly to the same extent. Finally, two cases have been met with of rats, which can hardly be considered as other than sports, occurring in groups large enough to occupy two adjacent houses to the exclusion of other species of rats. The members of such groups must be of close blood relationship,—in fact, "family groups" prone to inbreeding.

Moreover, there are two examples of what appear to be the same kind of sport having arisen independently in two far distant localities. These similar sports are in one case from Bombay and Madras, and in the other from Rangoon and Naini Tal. The former places resemble one another in climate. The latter places are utterly different from one another.

Although many examples of sports have been already described, the most important ones will be reviewed here.

Cases of single sports.

Case 1.—The rat "Mds. 2" is a *Mus rattus*; its ventral surface is dark brown, and in the middle line of the breast is a pure white streak. It was selected from among about 600 freshly killed rats of the *rattus* type, which were received during two days.

Case 2.—A black example of the *rattus* type caught in the Museum of the Bombay Natural History Society where it attracted attention owing to the pure white line on its breast. Although this line is not quite so long as in the last case, it seems to be essentially the same variation. A large proportion of the Bombay rats are of the black type of *rattus*. The same variation has also been noticed in Calcutta and at Nowgong.

Cases 1 and 2 are shown side by side in plate i.

Case 3.—One *Mus rattus* from the Punjab which shows a white-tipped tail, with some lengthening of the terminal hairs of that appendage. This case is specially mentioned because of the concomitant lengthening of the hairs. There are several examples of white-tipped tails among other species of *Gunomys*, *Bandicota*,

and *Mus*; in these, however, the occurrence is not associated with lengthening of the terminal hair.

Case 4.—One half-grown rat selected from some thousands of the mixed assembly of white-bellied *rattus* and *concolor* caught in Rangoon city, which differs in only one respect from many of the half-grown members of the white-bellied race. The under side of the tail of this rat is pure white. This is considered to be a most important variation, for on this peculiarity alone several species have been defined. This statement is open to criticism, but it cannot be denied that bicoloration of the tail is the most important feature in the definitions of those species of the genus *Mus* which have received the names of *niveiventer*, *vicerex*, *bukit*, *rapit*, etc., for the other less important details of the definition of these species seem to fall within the normal range of variability of the *Mus rattus* group, and the species have been defined from comparatively small numbers of specimens.

The fact that this young rat was only half grown is of importance; judging from its size it cannot be much more than two or three months old; this lessens the probability of its being brought to Rangoon by a foreign ship. Because of this and of the fact that it appeared to be unique among the large number examined, it is difficult to believe otherwise than that it was a sport, born of the white-bellied race of *Mus rattus* which is common in Rangoon. In case 8 we shall see another example of precisely this same variation, occurring in a gronp of rats fonnd to be occnpying two adjacent houses in Naini Tal.

Cases of more than one individual showing the same variation as sports which have been met at the same time and place.

Case 5.—An excellent example of this is from the Punjab. Captain Davys sent us from a village in the Amritsar district a pair of adult rats of almost exactly the same size and appearance. They are obviously of the *rattus* type, but can be distinguished at a glance from the others of that race among which they were found. They are much lighter in colour than the average Punjab *rattus*, though not lighter than certain exceptional individuals. They both have a pure white star on the forehead; the terminal third of their tails is white. The sender of these remarkable rats alluded to them tentatively as *Mus brahminicus*. There is very little doubt that if they had been sent together to any specialist, they would have been hailed as a new species. However, circumstances make it probable that in the capture of these two specimens, the new species would have become extinct before it was defined. They were almost certainly born of the same parents and were probably mates. The female was pregnant, carrying four embryos. They were caught in the village of Nowshera Dhala, in which over 800 of the normal *Mus rattus* had been taken. These

two specimens stand alone among 22,000 rats taken from the villages of the Amritsar district. In the remarkable character of their tails they exactly resemble a number of species which occur in the Eastern Archipelago.

Case 6.—A litter of five very young rats was brought to one of the collecting stations in Rangoon all of which were of a light buff colour and had unusually large feet. Two of them were subsequently reared to maturity by Captain Kelsall who found them to be typical examples of the Rangoon bandicoot, *Gunomys varius*, in everything but colour. On the same day that the writer first saw these rats, and at the same station, one adult specimen of exactly the same colour was received, the hind feet of which were 11 mm. longer than those of an equal sized specimen of the typical *G. varius*. Information was also obtained from the official in charge that at that particular station they had occasionally received such "sandy coloured bandicoots." It is clear that these interesting animals were to some extent established in that part of Rangoon, and they evidently breed true. Intermediate colour forms between them and the common blackish grey type were never met with. In Dr. Hossack's collection of Calcutta rats are two specimens of the smaller *Gunomys bengalensis* of exactly the same curious buff colour.

Cases in which a large group of sports was met with.

Case 7.—This is afforded by the ten black mole-rats described under Rng. 8 on page 76, where full details of the occurrence of these interesting animals will be found. They all resemble one another very closely indeed, and differ from the mean type of the race not only in colour but also in size and skull proportions. They seemed to be the only rats domiciled in two adjacent houses of a certain street in Rangoon. Black specimens of *G. bengalensis* are otherwise rare in Rangoon, and have never been recorded from any other place.

Case 8, *the Ayapata race of Naini Tal*.—Eight rats were caught in a certain house and adjoining buildings in Naini Tal. They are very like the rats found in the bazaar and other buildings of the station, in all but the one respect that their tails are bicoloured. This bicoloration is very variable in degree, but not by a varying diminution of pigmentation from the lower surface, in the manner that our preconceived ideas would lead us to expect. The actual occurrence is fully described on page 40 and illustrated on plates i and iv. It is difficult to believe otherwise than that these eight rats are closely related as a family group. No rat with a unicoloured dark tail was caught in those particular houses. In all other respects they are so like the common rats of Naini Tal that one is compelled to regard them as an offshoot from the local race. It has been mentioned before that bicoloration of the tail is the all-important feature in the descriptions of many species of the *rattus* group.

The circumstances of case 8 are different from those of case 7. In case 7 the chief peculiarity, blackness, which marks off the ten rats from the race out of which they have presumably arisen, is remarkably constant in degree. In case 8 the feature, bicoloration of the tail, which marks off the group, is so variable that at least four distinct "types" are present among the eight. It appears that a parallel case to this has been recently published. In Hossack's "Account of the Rats of Calcutta" is an illustration which is

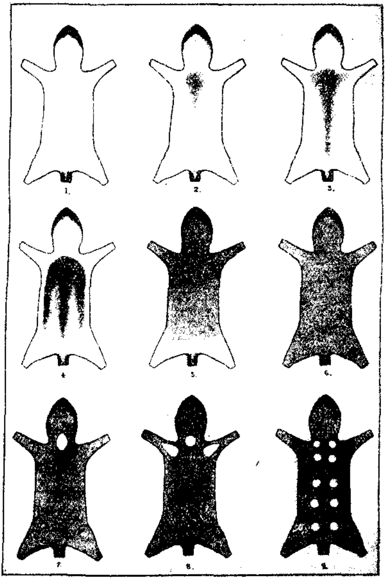

FIG. 9.—Illustration of variation in belly colouring in *Mus rattus* (after Hossack).

reproduced here (text-fig. 9); this is accompanied by the following statement: "As showing how endless are the combinations and variations of these different belly colourings, the figure in the text may be referred to, showing the different variations found in nine specimens of *M. rattus*, which represented the total bag for one day."

The concluding clause of this quotation is an important part of it. Having examined a certain number of the Calcutta *rattus*, the

writer does not think that Dr. Hossack could always select such a series of nine, as he has figured, from any 100 chance-taken rats of Calcutta. It is true that a similar series cannot be selected from nearly 2,000 specimens of *Mus rattus* from different parts of India. However, a similar series could be selected from 58 rats from Simla. And yet these nine are " the total bag for one day." The explanation seems obvious: this " bag " was made in one house or granary, and the contents of it represent a parallel case with the Ayapata family group.

Let us consider how similar these two cases are. Rats with dark (*i.e.*, any colour but pure white) under parts occur in vast majority throughout northern India, but white-bellied rats are common in certain places ; Calcutta is one of these. It may be safely assumed that the white-bellied type was derived from the dark-bellied type, and that the Ayapata race with their bicoloured tails were derived from the rats which possessed unicoloured dark tails. It seems to the writer that in the groups of the eight Ayapata rats and of the nine Calcutta rats,—groups which cannot each represent more than two or at the most three generations,—we can see the change from one race to another actually in progress. In both cases the change is associated with a variation of much wider range than that which is spoken of as normal variation.

It is not claimed that this assumption is already far justified by facts. Such communities might be looked upon as groups of hybrids between two established species. These two cases, however, wonderfully resemble a case recently described from another part of the animal kingdom, which cannot be explained in this way.

In a certain part of the Arabian Sea a community of the crustacean *Squilla* [16] was found. This community shows an extraordinary variability in one respect. Species of the genus *Squilla* possess as a rule six-spined claws, the number of spines being very constant for each species. The members of this particular community, however, all possess a greater number of raptatorial spines, the number varying from 10 to 19, among the seventeen specimens obtained. The number of spines is so variable that there are eleven " types " among the seventeen, some of them being unsymmetrical, but the number of spines in every individual is well above the number found in any other species of the genus. Except for these spines the specimens resemble one another as closely as the members of a species usually do. It seems that there are certain definite resemblances between this crustacean community and the two communities of rats which have just been referred to. In all three cases there is a local community differing from the general group of which it is a part, in that it possesses a certain character (presumably a newly acquired one)—albiventralism and caudal bicoloration in the case of the rats, multispinity in the case of the crustacean ; but in all three that character is in a most unstable condition, so that, as regards it, each community contains several types. At the same time there is little doubt that in each case the members of the community are of one stock and are not separated by more than two

or three generations. The variation in the character is, however, different in degree from that which is known as normal variation.

The " discontinuous distribution " of rats with white under parts, bicoloured tails, and of melanotic rats in the Oriental region is most interesting ; it has been already dealt with, but some of the facts may be shortly reviewed. White-bellied rats form a pure race in Rangoon (Rng. 2) ; they are common in Calcutta. Out of sixty-nine villages in the Punjab it was found that only three contained them in small numbers. The rats of Simla bazaar and of several other places on the flanks of the Himalayas are nearly all of this type. A few were obtained from Cawnpore and other places ; they form more than half of the rats received from Tellicherri. In many other places, however, they do not occur, and it cannot be doubted that the commonest type of *Mus rattus* in India is the dark-bellied one, and that the white-bellied type occurs sporadically (*vide antea*, pages 65, 80).

Rats with bicoloured tails, although rarer, show the same sort of distribution. There is a pure race of them in Kashmir. There is a race in the Eastern Himalayas (*M. jerdoni*). They have been recorded from Katmandu (*M. niveiventer*) and from Simla (*M. vicerex*), but it is doubtful whether they persist as a race in these two places at the present day (see p. 6). This year a small colony of them was met with in Naini Tal (Ayapata race), and one specimen was found in Rangoon. They have been frequently met with in the southern part of the Oriental region, in the Malay States and Archipelago, chiefly from hilly districts. Wherever met with they have shown other slight peculiarities, for they have been described as different species. But the bicoloration of the tail is admitted to be the most important character in all of them. In the two places Rangoon and Naini Tal where the writer met with rats of this sort *they did not differ, except in the one respect, from the common local races of those places from which they are thought to have been derived.*

Passing now to the cases of melanism, we find that black rats are not uncommon in Bombay [17]. They occur rarely in Calcutta. We have received pure black rats from Cawnpore and Freemantle (Australia). There is an interestiug semi-melanotic type among the Tellicherri collection. Ten pure black mole-rats were obtained from two adjacent houses in Rangoon. From the same town we have melanotic examples of *Mus concolor*, the miniature form of *Mus rattus*. It cannot be that the black *Mus rattus* gave rise to the black *Mus concolor* ; and the brown *rattus* to the brown *concolor*. Melanism must have been acquired independently by these two races.

After considering their discontinuous distribution it seems difficult to believe otherwise than that these three characters, melanism, albi-ventralism and caudal bicoloration, have arisen independently in several places, and are continually arising unnoticed in thousands of other places. It is somewhat difficult to know how far this view is accepted at the present day. It appears that some

naturalists, having discovered an isolated group of melanotic rats, would speculate as to what part of the world they or their progenitors had wandered from. It seems to the writer that the discontinuous distribution of species (using the actual meaning of the word for "anything that has ever received a specific name") can often be explained without postulating means of emigration.

A list of sports or groups of sports has been drawn up, but other cases have been described which have perhaps an equal right to a place on the list; such cases are Pjb. 2, Qta. 2, Alh. 3, Mds. 4, Tci. 1, Rng. 1*b*, Rng. 7*b* and *c*, Rng. 8*a*. In some of these cases the differences which mark off the groups are smaller than in others.

We have also seen that all the rats living in a particular house (or set of burrows), although closely resembling one another, often show, in certain features, recognisable differences from the mean of the race, although these differences are so small that they fall within the range of normal variation of those particular features exhibited by the general population. The differences which mark off these groups are small, but the groups showing them are very common. These small differences seem to be equivalent to the "family likenesses" of mankind, heightened perhaps by inbreeding.

It is interesting to consider the commonness of sports and groups of sports. Within a week at least four were met with in Rangoon. The total number of sports mentioned in this paper was selected from among not very many thousands of rats. The number of rats present in India and Burma must be some thousands of millions. Four thousand rats a day were destroyed in Rangoon for some months without producing much effect on the rat population which in that city alone must be several millions; over a million have already been killed there. Sports, therefore, must exist in large numbers, each with a small chance of forming a "family group," each of which has a very small chance of forming a race. In the different magnitude of their chances lies an explanation of the well known fact that rare species are many and common species are few.

In the writer's opinion "family groups" of sports have been frequently met with by naturalists who have described them as new species. Such species can seldom be rediscovered; they become extinct after a fitful survival through a few generations. They remain in our literature, however, as rare species. The chances of a "family group" developing into a race seems to be very small indeed. For while among the rats of India the birth of sports seems to be of daily occurrence, the number of established races is very small, though from its superfluity a race is much more likely to meet the eye than either a family group or a single sport.

In India we have sure evidence of only four established races of the *Mus rattus* type.

Race 1 (*Mus vicerex* ?).—In Kashmir most of the house rats have white under parts and relatively short tails which are devoid of pigment below. It has been said that they are of the species

of *Mus vicerex*, because they resemble in their peculiarities certain rats which were caught in Simla in 1896. The common rats of Simla are to-day different from the common rats of Kashmir, which form a distinct race.

Race 2 (*Mus nitidus* ?).—Rats caught this year in six different parts of the Darjiling district all agree in possessing relatively short tails, thick, soft, greyish fur, dark under parts and feet pure white above with black soles. They are of course variable like all other rats, but their variability is about a mean other than that of the common rats of the plains. Hossack, who caught two of these rats, regarded them as *Mus nitidus*.

Race 3 (*Mus blanfordi*).—In 1881 a peculiar rat was found at Kadapa in the Nilgiri Hills of Madras, and a little later another resembling it was found at the same place; both of these rats were distinguishable from the common type by the following features. The fur was thick and soft, greyish fawn above, white below, the ears were large; their tails were most peculiar, they were relatively long, and pure white in the distal half, the hair on the tail was unusually long and formed a terminal tuft. There are in the Indian Museum four other precisely similar specimens from the Shevaroy Hills which are nearly 200 miles from Kadapa, to the east of the Nilgiris. The peculiarities which were originally described in the skull of the "type" specimen are not constantly found among the four from the Shevaroys, which do not seem to differ in this respect from many of the common *rattus* type. There can, however, be no doubt that *M. blanfordi* is an established race in the Nilgiris.

Race 4 (*Mus jerdoni*).—Rats have been frequently obtained from the Himalayas of Sikhim and Assam which are peculiar in being bright rufous above, white below, and in possessing remarkably long bicoloured tails. In 1881 a close observer noticed that of five of these rats, all possessed a minute accessory palatal ridge between the two posterior ridges (4th and 5th) [**2**]. There are in the Indian Museum several similar rats; among them are three litters of young ones, two from Darjiling of two each, and one of three from Cherrapunji (Assam). Every member of each litter shows some irregularity of the posterior palatal ridges tending towards the interpolation of an extra one.

The number and form of the palatal ridges is most constant among rats. Besides the cases just referred to, the writer has only once found an abnormality in these structures although he has examined large numbers of them both in *Gunomys* and *Mus*.

The skulls of the *Mus jerdoni* in the Indian Museum could be distinguished from hundreds of the common *rattus* type owing to their remarkably small auditory bullæ. This point was discovered in other specimens in 1881. *Mus jerdoni* is therefore a distinct race in the Eastern Himalayas. It is said to occur in Java.

These are the only four special races of the *Mus rattus* type in the Peninsula of India of which we have sure evidence, although there must be many others. Local races showing albiventralism seem to be established in several places. One cannot assign a local

habitation to either *Mus fulvescens* or *Mus niveiventer*. Such forms as *Goalunda*, *Vandaleuria* and *Mus mettada* are considered to be quite distinct from the *Mus rattus* type.

If we consider in succession the numerous single sports, the small family groups of such sports (exampled by cases 5, 6 and 7), the larger groups (case 8), and the established races 1—4, they seem together to illustrate the process by which a new race arises from an old one.

During one week at least four well-marked sports were met with in Rangoon alone, whereas the established races of rats in India are very limited in number. Few sports can establish a family group, very few family groups can establish a race. One cannot do more than guess at the nature of the "fitness" which renders one sport successful and eliminates a dozen others. However, one can deny that all successful sports are so by virtue of the characteristic features which are obvious to our eyes. A short bicoloured tail, a long bicoloured tail, a sixth palatal ridge, a tufted tail are merely the marks of successful races, they are surely not the features which determine the success. The factors which determine the success of a group of rats may be a greater pugnacity or cunning, a greater resistance to certain diseases; and a greater fertility, combined with that mysterious factor prepotence; or they may be inconceivable.

Hitherto we have been considering races which show comparatively small differences from one another. There are in the fields round Amritsar two races of mole-rats living side by side always in separate colonies or sets of burrows. These show such structural differences from one another that they have received different generic names; one of these, *Gunomys*, is a genus which occurs throughout the whole of India. The other, *Nesokia*, seems to be confined to the north-west. *Gunomys* has a tail percentage of 80, small incisor teeth, a long palatine foramen and a large number of mammæ; it produces 8—12 young at one birth. *Nesokia* has a tail percentage of 50, large incisor teeth, and concomitantly a very short palatine foramen; few mammæ, and it produces 2—4 young at a birth. The skulls of these two genera are shown on plate iii. It may be safely assumed that *Nesokia* was derived from *Gunomys*.

If we suppose that it was derived from *Gunomys* by "natural selection" working on normal variation, we must assume that there were a number of steps linking together the two extremes. The steps—a series of hypothetical species now extinct—must have each shown, gradually and in turn, a reduction in the length of the tail and palatine foramen, fewer mammæ and young. Each of these hypothetical species must have fitted its environment and must have become changed in response to some slight alteration in that environment; although at the present day the two extremes are perfectly suited to what appears in our eyes to be the same environment.

The alternative view, that the first *Nesokiæ* were sports born from *Gunomys*, which established a family group and afterwards a widespread race, seems more in accordance with the evidence afforded by the present enquiry. The writer must confess that he has acquiesced in the generic distinction of *Gunomys* and *Nesokia* partly in order to heighten the effect of his argument. It must, however, be admitted that they are distinct animal forms, possessing characteristic features of more weight than those shown by some of the recently discovered species of *Mus*.

The writer has already expressed the opinion that the system of classification of animals now in vogne is unsatisfactory. The system seems unsatisfactory because it does not always offer a true picture of the way in which animal forms occur in nature. The systematist holds that every individual animal must be assignable to a particular species; and further, that species if properly defined, are elementary and indivisible, and approximately of equal value. This conception appears wholly true to those who examine small numbers of animals from many places. It must seem only partially true to those who examine large numbers of animals taken from a few places. It may be admitted that races such as those enumerated 1—4, which are regarded as elementary or true species, are approximately of equal value; but what is their relation to the heterogeneous mass of rats which extend through India and beyond, a race so definitely variable that three or more individual members of it living in Cawnpore in the heart of India, can be distinguished at a glance from one another, *while each one of them is indistinguishable from one of three individuals caught on a ship at Freemantle, Australia.* The members of this heterogeneous mass are bound together by the fact that they all possess the same type of skull, the same characteristic foot pads, and a tail variable in length, but seldom or never shorter than the head and body. Moreover, the races 1—4 also resemble the mass in these features but they are each clearly separated by their own special marks.

How can these various races be accurately represented by our nomenclature? It is surely absurd to name the heterogeneous mass *Mus rattus*, and to give the races 1—4 equivalent names. Systematists admit that *Mus rattus* is not a species equivalent to the others, but they seem to think that it will ultimately be possible to split it up into a number of equal groups, each a true indivisible species. Hossack's figures show that it is not possible, and the writer has met with the same impossibility.

One writer, in dealing with Siamese rats [18], simply excludes the common rats from his system. Another places the common rat of Borneo [19] in the group of the European house rats and describes them as "a group which has been the bane of workers on the Oriental Muridæ, and which at present owing to want of material is quite impossible to bring into any sort of order." The conviction is expressed here that it will ultimately be possible to place these rats in the Linnean system.

The conception which is in accordance with the Linnean nomenclature may be illustrated by text-fig. 10, in which the thick line represents the old species, the thin lines the new species into which it has been divided, the dotted lines representing the work of the future. This is pleasingly simple and hopeful of finality, but it does not seem to represent the way in which the animals occur in nature.

FIG. 10.

The diagram, text-fig. 11, is perhaps more in accordance with the actual occurrence. In this diagram the central thick line which represents the species *Mus rattus* is supposed to consist of a mass of tangled lines which are individually visible as the terminal twigs A. These represent the family groups, the members of which show very slight differences from one another, differences which are equivalent to the family likenesses of man. These twigs are represented because ten rats taken from any single house in a town will often resemble one another more closely than ten rats taken haphazard from different houses in the town. Some of these groups are slightly removed from the mean of the race, but all are not so to an equal extent. The mean of the race is represented by the vertical line XX. Those groups which in their characters diverge widely from the mean are represented at a wider angle from the parent stem. A well-marked sport will therefore come off almost at a right angle. The many sports and family groups which are unsuccessful are represented by short lines, the few successful ones which have established a race are indicated by longer and thicker lines, which themselves show side-lines like the parent stem. *A line which does not deviate much from the mean may be an old and powerful one*: for example, *Mus concolor* only differs in size from *M. rattus*, but it is a well-established line; its members extend throughout Burma and far beyond to the south; it clearly shows its own side-lines, which are often of the same kind as those of the parent stem. On the other hand a line such as *Mus blanfordi* which deviates widely from the mean may also be well established.

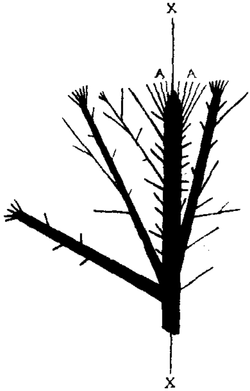

FIG. 11.

Not every species could be accurately represented by this diagram. The line of *Mus decumanus* would be shown with terminal twigs but without any established side-lines, for in India the race shows exactly the same fluctuating or normal variation as *Mus*

rattus, but never a sport. However, this assertion may at any moment be proved to be erroneous.

This idea of the relations of the many races of Oriental rats to one another has not the merit of simplicity, and is not in accordance with the Linnean system of nomenclature.

In concluding this appendix, I must acknowledge that as regards many of the ideas expressed in it I am much indebted to a book by R. K. Lock, entitled "Variation, Heredity and Evolution" (1907), which contains a clear exposition of the teachings of Mendel, Bateson and De Vries, teachings which seem more in accordance with nature than those usually expounded as Darwinism.

Lest it may seem that I have been unduly biassed by Mr. Lock's book I hasten to add that "Mutation, Mendelism and Natural Selection," by Professor E. B. Poulton (1908), has also been read. The author of this essay considers that a natural consequence of such ideas as those expressed in Lock's book is "a widespread belief among the ill-informed that the teaching of the founders of modern biology are abandoned."

These opinions, therefore, are put forward with diffidence, and I have felt the need of that criticism and discussion which are so necessary to temper fresh ideas.

APPENDIX III.

ENMITY BETWEEN THE VARIOUS RACES OF RATS.

The question of the cause of the ascendancy of particular races is important. It has been assumed that the absence of *Mus decumanus* from Madras is due to the fact that in its habits this rat resembles *Bandicota indica*, and that since the bandicoot is much the more powerful rat, it can secure the drains of the city for itself alone. This raises the question as to whether special enmity between particular races exists. Some evidence has been obtained and more might be the outcome of simple experiment.

The subject was first brought to my notice by Captain Davys, who found that if a living shrew were placed in a cage with a young living *Mus rattus*, the shrew seized the head of the rat with its powerful incisor teeth and after biting through the skull devoured the brains. I was subsequently reminded of this habit of the shrew when at Rangoon. It happened that a cage containing a living shrew (the grey "musk rat" *Crocidura cærulea*) was placed in contact with a pile of dead *Mus concolor*. The shrew dragged the foot of one of the rats through the bars of the cage and commenced devouring it. The dead body of the rat was placed inside the cage. The shrew continued to devour it, applying itself to the extremities, the snout, muzzle, ears and feet in succession. Six living *Mus concolor* were placed in a cage with one shrew; without a moment's delay they combined forces against the shrew. The fact that they

were all captives in the cage did not deter them from showing their natural antipathy. The shrew betook itself to a corner of the cage and faced its aggressors who seemed unable to accomplish anything against the shrew's powerful incisor teeth. One adult *concolor* and a shrew were then placed together in a cage; the shrew became the aggressor at once and pursued the other vigorously for about five minutes. An adult *concolor*, however, is a most active rat, and the experiment ended by both coming to rest in opposite corners of the cage.

On the other hand, it was often noticed that if *Mus concolor* and the white-bellied *Mus rattus* of Rangoon were placed together in a cage they showed no signs of antipathy. Members of these two races are sometimes caught together in the same trap.

In continuation of the subject I will quote a letter received from Captain Davys.

"Have you ever noticed that if a big *Gunomys* and *Gerbillus indicus* are put into a cage together, the *Gunomys* at once attacks and kills the *Gerbillus*, or *Gerbilli*. Even when the cage is being carried by a man the *Gunomys* does this. He seems to have a special hatred of the *Gerbillus*. Last night I put three *Mettada* and three *Gerbillus* into a cage with one *Gunomys*. The *Gunomys* killed all the three *Gerbilli* within ten minutes, but did not interfere with the *Mettada*." It may be mentioned that *Mus mettada* is a much smaller rat than *Gerbillus*.

It seems therefore that special enmity exists between particular races of rats.

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EXPLANATION OF PLATE I.

FIG. 1.—Two specimens of *Mus rattus* showing white breast stripes. One was found at Bombay and the other at Madras city ; both were selected from among large numbers of the common rats of those cities. Individual rats showing this character have also been obtained from Calcutta and Nowgong.

Quite recently I obtained at Poona a litter of four young rats and an adult, all of which resembled the specimen on the left of the figure. The common rats of Poona are uniformly coloured below.

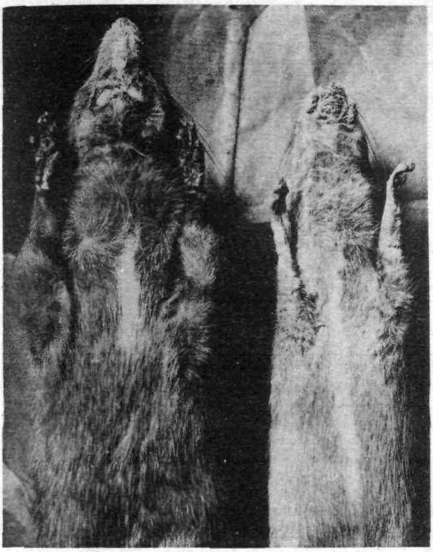
It appears, therefore, that this character is definite in *Mus rattus*, and that it appears independently among the rats of widely separate localities and is heritable.

FIG. 2—*a*. Tail of a normal *Mus rattus* for comparison.

b. Side view of the tail of one of the Ayapata race (p. 42). This is one of the several types of tail coloration found among this race. The others are shown in plate iv. This particular type resembles, in the pigmentation of its tail, *Mus berdmorei*, a "species" recorded from Manipur and Tenasserim.

c. Side view of the tail of one of the sports also shown in fig. 3. The change from the pigmented to the unpigmented skin is abrupt. At the junction the white area invades the dark area in an irregular manner. Some specimens of *Mus blanfordi* which have been preserved in spirit show a *precisely similar appearance* at the junction of the coloured and colourless portions of the tail.

FIG. 3.—Heads of the two abnormal *Mus rattus* found near Amritsar (p. 22). The tails of these rats were as alike as their heads ; one of them is shown above (fig. 2*c*).



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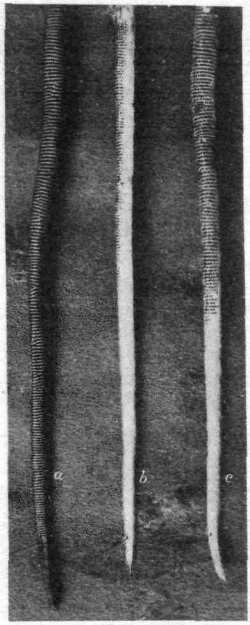

Fig. 2

Fig. 3.

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EXPLANATION OF PLATE II.

FIG. 1.—Seven adult specimens of *Nesokia* from the Amritsar district showing the gradation and amount of variation in size. They probably represent two separate races, for the smallest ones seemed to be segregated near the village of Atari. The isolated specimen on the right is an average member of the Quetta race of *Nesokia*; it is somewhat larger and has a shorter tail than the Amritsar race.

FIG. 2.—Skulls of the same seven specimens. It can be seen in three skulls that the last molar tooth is well worn; all seven are in this condition; their maturity cannot be questioned. Apart from the difference in size, there are noticeable differences in form. In the skull marked P. C. M. 2 the supratemporal ridges are more conspicuous and much more adjacent than in S. B. B. 18. These differences are characteristic of the larger and smaller types respectively.

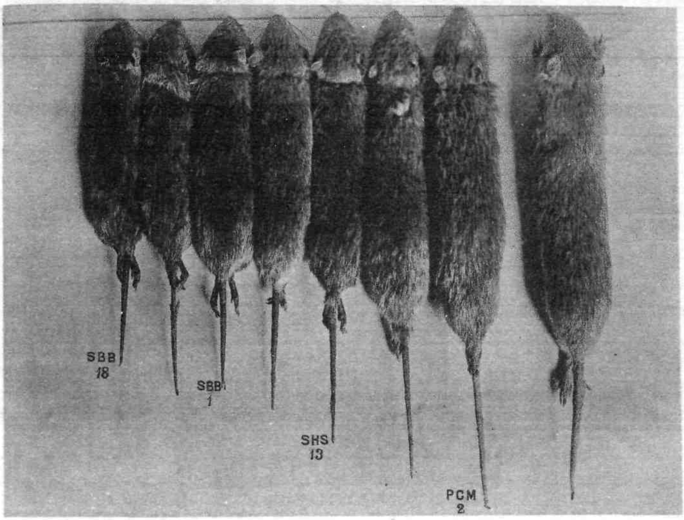

Fig. 1.

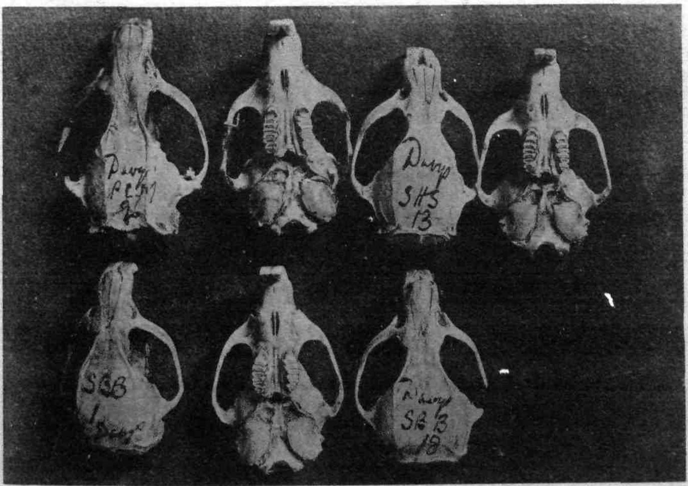

Fig. 2

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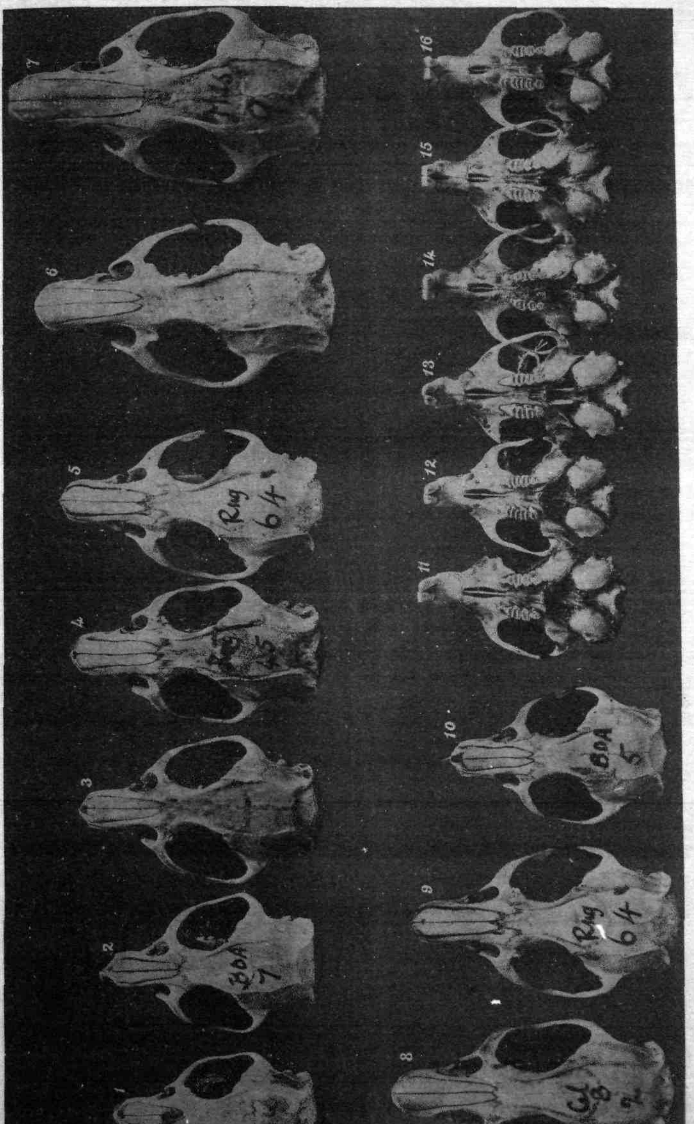
EXPLANATION OF PLATE III.

SKULLS OF *Nesokia, Gunomys* AND *Bandicota.*

No. 1. *Gunomys bengalensis* of Calcutta.
,, 2. ,, sp. of Amritsar.
,, 3. ,, ,, of Simla.
,, 4 and 5. *Gunomys varius* of Rangoon.
,, 6. *Bandicota nemorivaga* of Calcutta.
,, 7. ,, *indica* of Madras city.
,, 8—10. Skulls of *Bandicota nemorivaga*, *Gunomys varius* and *Gunomys* sp. of the Punjab, arranged to show their relative resemblances.
,, 11—13. *Gunomys* sp. from Amritsar.
,, 14—16. *Nesokia* sp. from Amritsar.

Nos. 11 to 16 show the difference between the palatine foramina of the two genera; Nos. 12 and 15 are selected as an average specimen of each. In No. 13 the palatine foramen is closed posteriorly on the right side. In No. 14 the palatine foramen is of unusual length for a *Nesokia*. Skulls like No. 11, in which the palatine foramen is widely open posteriorly, are not common.



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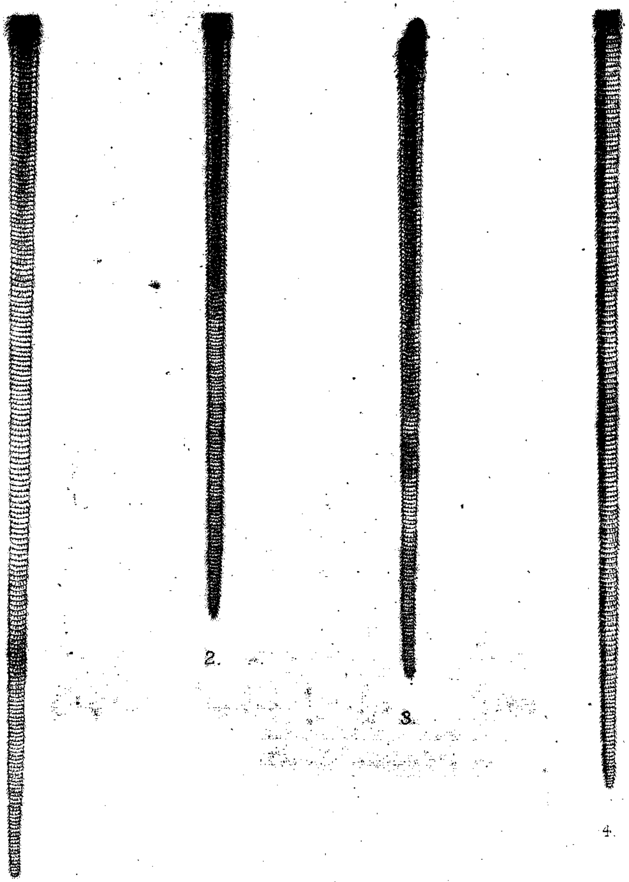
EXPLANATION OF PLATE IV.

FIGS. 1—3. Tails of *Mus rattus* of the Ayapata race, from above.
FIG. 4. Tail of ,, ,, ,, from the side.

Rec. Ind. Mus., Vol. III, 1909. ~~Extra No., 1908.~~

Plate IV. ~~A.~~



1. 2. 3. 4.

A. Chowdhary, del. et Lith.

EXPLANATION OF PLATE V.

Records of measurements of 85 *Gunomys* and 24 *Nesokiæ* from Amritsar, and 43 *Mus concolor* and 17 white-bellied *Mus rattus* of Rangoon.

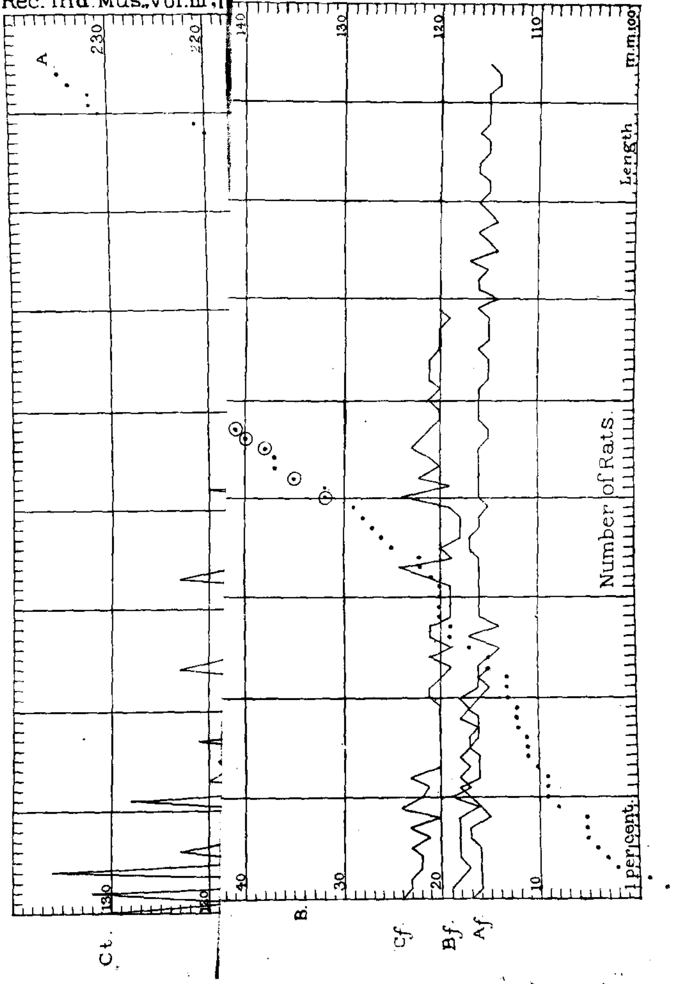
The dots indicate the actual lengths of the rats, and must be referred to the right-hand column of figures, which represents millimetres.

The zigzag lines represent percentages of the lengths of tail and hind foot in the actual lengths, and must be referred to the left-hand column of figures.

A., *At.*, *Af.* = length, tail percentage and foot percentage of *Gunomys*.

B., *Bt.*, *Bf.* = length, tail percentage and foot percentage of *Nesokia*.

C., *Ct.*, *Cf.* = length, tail percentage and foot percentage of *Mus concolor* and of the white-bellied *Mus rattus* of Rangoon. The lengths of the latter are indicated by the circles.


A
B.
Ct.
Cf.
Bf.
Af.
230
220
140
130
120
110
100
40
30
20
10
mm.
Length
Number of Rats.
1 per cent.

EXPLANATION OF PLATE VI.

Diagram showing the weight-frequency of 3,000 house rats of all ages which were caught in the neighbourhood of Amritsar.

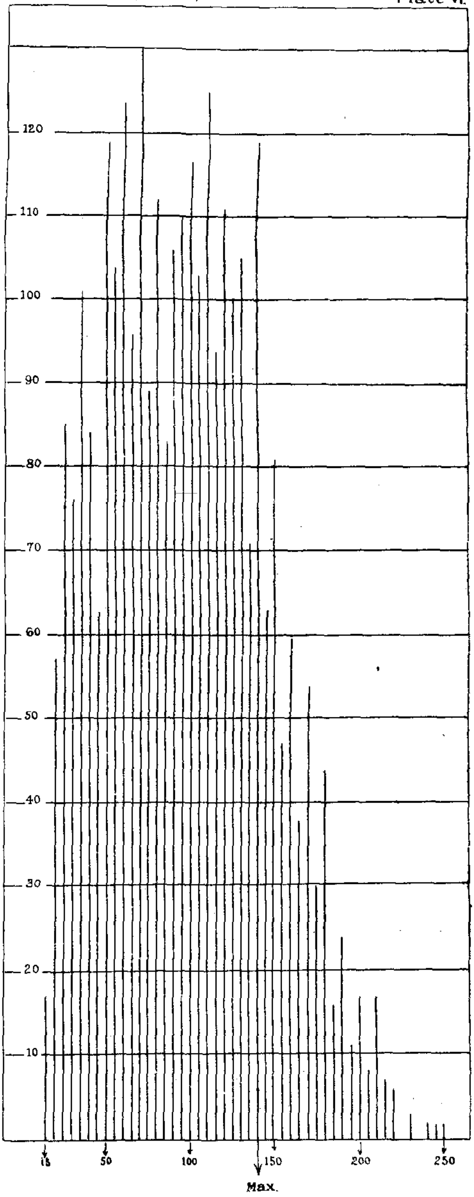
The figures on the base line represent a series of weights ascending by increments of 5 grammes from 15 to 250 grammes.

The lengths of the upright lines are proportional to the number of rats of (or nearly of) each weight. The mean weight of the adult rats is known approximately from the point at which the uprights begin to diminish in length, on the right of the diagram. It cannot be greater than 150 gms., although a few rats weighing as much as 250 gms. were met with.

It appears, therefore, that the normal range of weight-variation among the class is from 50 to 250 gms. A pregnant female weighing 65 gms. was obtained.

It will be noticed that the uprights are alternately long and short; this is due to the methods employed, and is of no significance. The rats were weighed with a spring balance, recording to 5 gms. The occasional difficulty of deciding between fives and tens must have been too often decided in favour of the latter.

The diagrams have been constructed from records provided by Capt. Davys.


120
110
100
90
80
70
60
50
40
30
20
10
15
50
100
150
200
250
Max.

II. NOTES ON FRESHWATER SPONGES.

By N. ANNANDALE, *D.Sc., Superintendent, Indian Museum.*

X.—REPORT ON A SMALL COLLECTION FROM TRAVANCORE.

Genus SPONGILLA.

Subgenus Euspongilla.

Spongilla travancorica, sp. nov.

Sponge small, encrusting, without branches, hard but brittle; its structure somewhat loose; colour dirty white. Dermal membrane in close contact with the skeleton; pores and oscula inconspicuous. Surface minutely hispid, smooth and rounded as a whole.

Skeleton consisting of moderately stout and coherent radiating fibres and well-defined transverse ones; a number of horizontal spicules present at the base and surface but not arranged in any definite order No basal membrane.

Spicules.—Skeleton spicules smooth, pointed at either end, moderately stout, straight or curved, sometimes angularly bent; curvature usually slight. Free microscleres abundant in the dermal membrane, slender, nearly straight, gradually and sharply pointed, profusely ornamented with short straight spines, which are much more numerous and longer in the centre than near the ends. Gemmule spicules stouter and rather longer, cylindrical, terminating at each end in a sharp spine, ornamented with shorter spines, which are more numerous and longer at the ends than in the centre; at the ends they are sometimes directed backwards, without, however, being curved.

Gemmules firmly adherent to the support of the sponge, at the base of which they form a layer one gemmule thick; each provided with at least one foraminal tubule, which is straight and conical; two tubules, one at the top and one at one side, usually present. Granular layer well developed. Spicules arranged irregularly in this layer, as a rule being more nearly vertical than horizontal but pointing in all directions, not confined externally by a membrane; no external layer of horizontal spicules.

Length of skeleton spicule	0·289—0·374 mm.
Greatest diameter of skeleton spicule	0·012—0·016 ,,
Length of free microscleres	0·08 —0·096 ,,
Greatest diameter of free microscleres	0·002 mm.
Length of gemmule spicule	0·1 —0·116 ,,
Diameter of ,, ,, ...	0·008 mm.
,, ,, gemmule	0·272—0·374 ,,

Habitat.—Backwater [1] near Shasthancottah, Travancore, in slightly brackish water; on the roots of shrubs growing at the edge; November, 1908.

This species is easily distinguished from its allies of the subgenus *Euspongilla*, all of which are closely related, by its adherent gemmules with their (usually) multiple apertures and rough external surface.

Genus TUBELLA.

Tubella pennsylvanica, Potts.

Potts, *Proc. Acad. Nat. Sci. Philadelphia*, 1887, p. 251, plate xii.

By the kindness of the authorities of the Smithsonian Institution I have been able to obtain pieces of the freshwater sponges in the collection of the United States National Museum. As the majority of these were named by Potts, the acquisition is an extremely valuable one. It enables me to identify with certainty several Indian species with American forms, amongst others the one of which the name is printed above, *viz.*, *Tubella pennsylvanica*. This species, found by Potts in Pennsylvania, New Jersey and other parts of the Eastern United States, was afterwards reported from the west of Ireland by Hanitsch (*Irish Naturalist*, iv, p. 129, 1895) and from the Inner Hebrides of Scotland by myself (*Journ. Linn. Soc.*, xxx, p. 248, 1908). None of the European specimens as yet discovered, however, have contained gemmules, and their identification has therefore remained a little doubtful. Specimens recently collected in Travancore are full of gemmules and agree more closely in every respect with one of the American specimens examined than this specimen does with a second one from the United States. They have the somewhat slender pointed skeleton spicules and markedly unequal rotules of the gemmule spicules of the typical form of the species. Indeed, the American specimen which they resemble so closely is apparently part of the same specimen as that of which the spicules are figured by Potts in fig. 1 of plate xii of his monograph.

The measurements of the spicules of an Indian specimen and of one from Lehigh Gap, Pennsylvania, are given for comparison:—

	Travancore.	Pennsylvania.
Length of skeleton spicule ..	0·189 — 0·242 mm. (average 0·203 mm.)	0·16 — 0·21 mm. (average 0·195 mm.)
Breadth ,, ,, ,, ..	0·0084 — 0·0155 mm.	0·0084 mm.
Length of birotulate ..	0·0126 mm.	0·0099 ,,
Diameter of upper rotule ..	0·0084 ,,	0·0084 ,,
,, lower ,, ..	0·0189 ,,	0·0168 ,,
,, gemmule ..	0·243 — 0·348 mm.	0·174—0·435 mm.

[1] The backwaters of Cochin and Travancore are a series of lagoons directly connected at intervals with the sea, from which they are separated by a more or less narrow extent of land. They have been artificially joined together by canals and receive a good deal of fresh water. Their salinity varies with the place and the season.

The spicules of the Travancore specimen are, therefore, a trifle larger than those of the American one, but the proportions are closely similar.

The other Indian species I have been enabled by the gift of the Smithsonian Institution to identify with American ones are my *Ephydatia indica*, which becomes a synonym of *E. cratcriformis* (Potts), and *Trochospongilla phillottiana*, which is identical with *T. leidyi* (Carter).

It is interesting to note that none of these American species is confined in India to the immediate neighbourhood of the sea. *E. cratcriformis* has been found not only in Calcutta but also at Igatpuri in the Western Ghats and at a place some miles inland from Moulmein in Lower Burma. *T. leidyi* occurs both in Calcutta and in the interior of Tenasserim ; while my specimens of *Tubella pennsylvanica* were taken (in November, 1908) in Shasthancottah lake, which is situated about three miles inland from the village of the same name on the backwater and about twelve miles N.-N.-E. from Quilon on the coast of Travancore.

The South Indian specimens were taken on the roots of floating water plants so matted together as to form large floating islands on which shrubs and even trees were growing. The sponges were only found on roots dragged out from under the islands and seemed to shun the light.

Genus PECTISPONGILLA, gen. nov.

Structure of the sponge resembling that of *Ephydatia*. Gemmule spicules bearing at either end, *on one side only*, a double row of spines, so that they resemble, when viewed in profile, a couple of combs joined together by a smooth bar.

This new genus is distinguished, as are most of those previously described in the Spongillinæ, by the form of its gemmule spicules. These differ from the spicules of any form hitherto described in having the armature of the extremities bilateral instead of radial. Probably this arrangement is derived from that of a spicule such as the birotulate of *Ephydatia* by a rotation of the axis of the rotules.

Pectispongilla aurea, sp. nov.

Sponge forming small, soft, cushion-like masses of a deep golden colour (dull yellow in spirit) on a solid support ; the surface smooth, minutely hispid. One relatively large, depressed osculum usually present in each sponge ; pores inconspicuous ; dermal membrane in close contact with the parenchyma.

Skeleton consisting of slender and feebly coherent radiating fibres as a rule two or three spicules thick, with single spicules or ill-defined transverse fibres running horizontally. Towards the external surface transverse spicules are numerous, but they do not form any very regular structure.

Spicules.—Skeleton spicules smooth, sharply pointed, straight or nearly so. Gemmule spicules minute, with the stem smooth and cylindrical, relatively stout, and much longer than the comb at either end; the two combs equal, with a number of minute, irregularly scattered spines between the two rows of stouter ones. No free microscleres.

Gemmules minute, spherical, with a single aperture, which is provided with a very short foraminal tubule; the granular coat well developed; the spicules arranged in a slanting position, but more nearly vertically than horizontally, with the combs pointing in all directions; no external chitinous membrane.

Length of skeleton spicule	0·2859 mm.
Greatest diameter of skeleton spicule ..	0·014 ,,
Length of gemmule spicule	0·032—0·036 mm.
Length of comb of gemmule spicule ..	0·016 mm.
Greatest diameter of shaft of gemmule spicule.	0·004 ,,
Diameter of gemmule	0·204—0·221 mm.

Habitat.—Artificial pool on the road near Tenmalai on the western side of the Western Ghats, Travancore; on the roots of trees growing at the edge; November, 1908.

I have not been able to detect vesicular cells in the parenchyma of this species, although my specimens are in good condition. *Pectispongilla aurea* is by far the most brilliantly coloured freshwater sponge I have seen.

EXPLANATION OF PLATE XII.

FIG. 1. Fragment of the skeleton of *Spongilla travancorica*, × 70.

,, 1*a*. Skeleton spicules of the same species, × 240.

,, 1*b*. Free microscleres of the same species, × 240

,, 1*c*. Gemmule spicules of the same species, × 240.

,, 1*d*. Outline of the gemmule of the same species as seen from the side, × 70.

,, 2. Fragment of the skeleton of *Pectispongilla aurea*, × 70: *g.* = gemmule.

,, 2*a*. Skeleton spicules of the same species, × 240.

,, 2*b*. Gemmule spicules of the same species, × 240.

,, 2*c*. The same more highly magnified (× 720).

,, 2*d*. Gemmule of *Pectispongilla aurea* viewed from the side, × 240.

Rec. Ind. Mus., Vol. III. 1909.

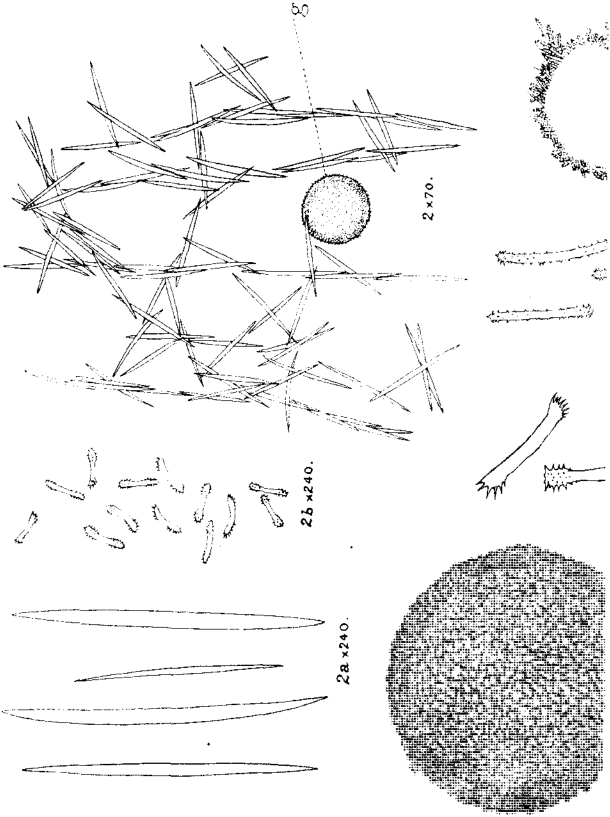


Plate XII.

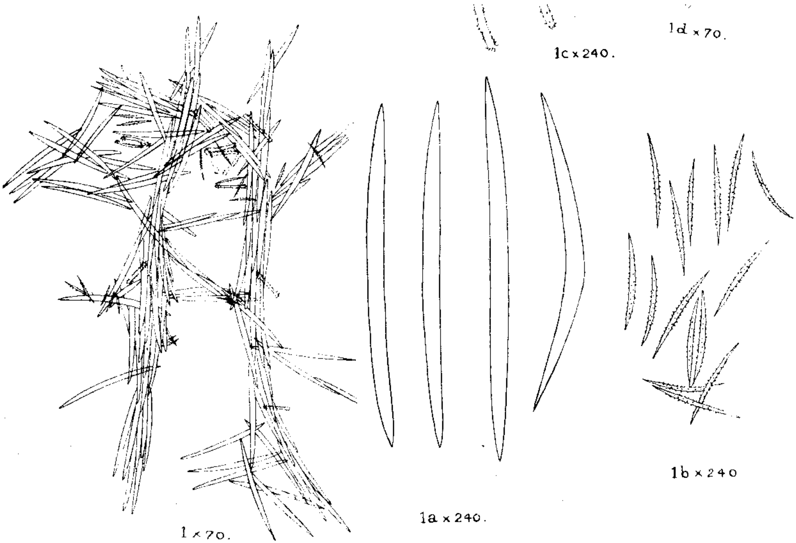


Fig.1. Spongilla travancorica sp. nov.   Fig.2. Pectispongilla aurea, gen. et sp. nov

III. REPORT ON A COLLECTION OF AQUATIC ANIMALS MADE IN TIBET BY CAPTAIN F. H. STEWART, I.M.S., DURING THE YEAR 1907.

PART II.—OLIGOCHÆTE WORMS, MOLLUSCA AND FISH (*Geographical*).

REPORT ON A COLLECTION OF THE SMALLER OLIGOCHÆTA MADE BY CAPT. F. H. STEWART, I.M.S., IN TIBET.

By J. STEPHENSON, *Major, I.M.S., Professor of Biology, Government College, Lahore.*

(Plate viii.)

The collection of the smaller Oligochæta, made by Capt. F. H. Stewart, I.M.S., in Tibet during the year 1907, consisted of fourteen tubes, with the contents of which the following report deals.

The specimens were on the whole in a good state of preservation, but the free ends of the setæ of many specimens had suffered severely, and a number of the animals also had apparently been fixed with a brown staining substance, which hindered subsequent staining and seemed to interfere with the section-cutting process.

The contents of two of the tubes were unfortunately incapable of recognition :—

No. 68 (Mang-tsa, Tibet ; 14,500 ft. ; July 1907) contained a considerable number of specimens. These were the largest animals submitted to me ; they measured up to 35 mm. ; the segments numbered up to 175. They were all, however, sexually immature, and I was unable to distinguish either clitellum or genital organs ; possibly this was a young brood of some earthworm, *i.e.*, of one of the larger Oligochæta.

No. 80 (Mang-tsa, Tibet ; 14,500 ft. ; 12-viii-07) contained three specimens, and sections show that they belong to the Tubificidæ ; but the setæ had, in this instance, suffered so severely that I was unable, in any of the specimens, to discover a single sound one in either dorsal or ventral bundles ; further discrimination is therefore impossible.

The contents of the remaining twelve tubes comprised only five distinct species, owing to the large number (seven) which contained the form described below as *Limnodrilus* sp. (?).

Chætogaster orientalis was found three times ; one tube containe both this form and a *Nais*.

It will be seen that the collection is of considerable interest in spite of the small number of species represented. One forn (*Fridericia stewarti*) I have ventured to name as new ; it is possibl that two others, the *Nais* and the *Limnodrilus* (?), are also new though I do not feel justified in giving them distinctive names. Of the remaining two species, one, *Æolosoma hemprichi*, is already well known to be widely distributed (Europe, North America, Africa), and I have also found it at Lahore ; the other has so far been met with only by myself in Lahore ; but since the name which I gave to it had been previously appropriated, its present specific designation (*Chætogaster orientalis*) makes its first appearance here.

The greater part of this investigation was carried out at the Central Research Institute, Kasauli, during the summer vacation of the present year (1908) ; and my best thanks are due to the Director, Lieut-Col. Semple, R.A.M.C., for kindly permitting me to pursue my work there.

Æolosoma hemprichi, Ehrbg.

No. 84. Gyantse, Tibet ; 13,120 ft. ; 27-viii-07.
Three specimens, of which the smallest appeared to be the broken-off posterior end of one of the others.

Length of both the larger specimens, including in each case one bud posteriorly, ·7 mm. ; diameter, ·09 mm. Colour, a rather dirty green ; the oil-drops in the skin quite disappeared. These latter are apparently incapable of preservation ; according to Capt. Stewart's notes their colour was an orange-brown, nearer an orange-red than a brown, and not unlike that of safranin stain. Segments, 8 or 9 distinguishable in the anterior or parent animal. Setæ commencing a short distance behind the mouth, *i.e.*, in segment ii ; all are fine hair-setæ, in both dorsal and ventral bundles ; length varying, longer and shorter in the same bundle, longest being about ·1 mm. ; up to 5 in a bundle.

Prostomium large ; both specimens having curled themselves dorso-ventrally at the moment of fixation are seen in a lateral view in the preparations, and the breadth of the prostomium does not appear. According to a sketch of Capt. Stewart's from the living worm, it was rounded, not pointed in front, and broader than the following segments. The nerve-ganglion is shown as being deeply indented posteriorly ; this also could not be made out in the preserved specimens. The nephridia also are not recognizable.

In all the anatomical characters that can be ascertained this form agrees with *Æolosoma hemprichi*, except that its length is considerably less. The present specimens, probably somewhat contracted, and perhaps also diminished by the loss of some posterior buds, measure ·7 mm. ; while *Æ. hemprichi*, according to Michaelsen ("Oligochæta," in *Tierreich*, Berlin, 1900), has a length of

2—5 mm. This can hardly, I think, be accounted a specific difference. I have recently [*Mem. Ind. Mus.*, i, No. 3*b*, p. 277, pl. xx (1908)] given a description of an *Æolosoma* from Lahore, identifying it as *Æ. hemprichi*, which is about the dimensions of these specimens from Tibet, and which is therefore also considerably smaller than *Æ. hemprichi* according to the figures given above.

Chætogaster orientalis, nom. nov.

1907. *Chætogaster pellucidus*, Stephenson, *Rec. Ind. Mus.*, vol. i, p. 237 (1907).

No. 42. Se-chen, Tibet; 13,100 ft.; 22-iv-07.
Three specimens without sexual organs, and one fragment, together with the specimen of *Nais* sp.

No. 49. Gyantse, Tibet; 13,120 ft.; 26-vi-07.
Two specimens without sexual organs; dark brown in colour, probably due to mode of fixation.

No. 83. Gyantse, Tibet; 13,120 ft.; 20-viii-07.
Two specimens without sexual organs, with several fragments consisting of detached buds.

The specimens probably consisted originally of complete chains of four or five individuals, which broke up at the moment of killing and fixing. They correspond closely with the species described by me as *C. pellucidus* from Lahore. Since writing that account (referred to above), however, I have, through the kindness of Dr. Walton, of Kenyon College, Gambier, Ohio, U.S.A., received a copy of his paper "The Naididæ of Cedar Point, Ohio," 1906 (*American Naturalist*, vol. xl, No. 478); he there describes as *C. pellucidus* a species found by him; and since the name belongs by priority to that form, I have chosen *orientalis* for the species now under discussion.

I was at first iuclined to see a differeuce between the present specimens and the form previously described by me in the relative length and thickness of the pharyngeal region as compared with the posterior part of the body. I find, however, that in the processes of fixation, etc., the pharyngeal region contracts both in length and breadth, while the body in the "crop" region appears to become broader than in life; in specimens from Lahore so treated the result is a close approximation to the condition in which the Tibet specimens were found, *e.g.*:—

	Length of pharyngeal region.	Length of body posterior to pharynx.
Lahore form ..	·25 mm.	·71 mm.
Tibet No. 83 ..	·29 ,,	·75 ,,
Tibet No. 49 ..	·088 ,,	·24 ,,
Tibet No. 42 ..	·11 ,,	·35 ,,

Sketches made during life by Capt. Stewart confirm the above identification, showing the animal to possess about the same proportions as living specimens of the Lahore form.

It will be noted that the individuals of the collections Nos. 42 and 49 are considerably smaller than those of No. 83. Since, however, the size is the only point of difference I can discover, I have not separated them as a distinct form.

Since in distinguishing the species of the various families of the Naididæ so much depends on an exact description of the setæ, I will add here a somewhat more detailed account of those of this species than I gave in my earlier paper. The setæ are ventral only, slender, ʃ- shaped, unequally forked, the distal prong being somewhat the longer, both prongs of the same diameter at the base, nodulus small, somewhat proximal to the middle of the length of the seta ; setæ of segment ii a little stouter and distinctly longer (·14 mm., Lahore specimens) than the rest (average ·11 mm., Lahore specimens).

Nais sp.

No. 42. Se-chen, Tibet ; 13,100 ft. ; 22-iv-07.
A single specimen, without sexual organs, along with specimens of *Chætogaster orientalis*.

Length 2 mm. ; segments xviii *plus* a short posterior region without setæ, the seat of budding of new segments. Prostomium rounded. Ventral setæ with a ʃ-shaped curve, hooked and bifid distally, distal prong longer than proximal ; nodulus not distinguishable in the present specimen ; beginning in segment ii ; 2—3 (perhaps more originally) in bundle. The anterior and posterior bundles differ somewhat ; the anterior are composed of setæ about ·074 mm. in length, with the distal prong of the forked end of the same thickness as the proximal ; in the rest of the body the ventral setæ are about ·055 mm. long, or three-quarters the length of those of the first few bundles, and the proximal prong is very considerably stouter than the distal. The thickness of the shaft of the seta is, however, the same throughout the body.

Unfortunately a small quantity of foreign matter adheres to the ventral surface of parts of the animal, and the setæ in these places being obscured, I am unable to say how many segments are comprised in the anterior group ; probably, however, as in *N. obtusa*, the setæ of segments ii—v belong to the anterior, the rest to the posterior group.

The dorsal setæ begin in segment vi ; each bundle appears to consist normally of one long smooth hair-seta, and one short, straight, singly-pointed needle-seta supporting it at its base, and scarcely projecting beyond the surface. These dorsal bundles, however, have been much damaged.

Two eyes are present as pigmented patches situated laterally at the level of the anterior lip of the mouth.

The pharynx occupies segments iii—v, the œsophagus vi, and a dilatation (stomach) of somewhat irregular shape appears in segments vii—viii. Posterior to this, the intestine is widely and regularly dilated in each segment. The anus is slightly dorsal.

The discrimination of the various species of the genus *Nais* depends largely on the characters of the setæ. Though the present specimen does not agree exactly with any form hitherto described (coming closest perhaps to *N. obtusa*, Gerv.), I prefer not to erect a new species on the basis of a single preserved specimen, especially as the dorsal setal bundles are largely incomplete. I myself examined previously some scores of living examples of a *Nais* common at Lahore before arriving at what I considered an adequate description of the dorsal setal bundles.

Fridericia stewarti, sp. nov.

No. 32. High Hill Gompa, Gyantse, Tibet; 14,500 ft; 28-iii-07. Six specimens, mostly with sexual organs (ova and yolk).

Length 8 to 22 mm. Colour yellowish. Segments about 45 (43—46). Prostomium short, rounded; external annulation fairly well marked. Clitellum on segment xii and most of xiii; may spread partly over xi. Epithelium of surface markedly thicker over prostomium. Head pore apparently between prostomium and segment i; dorsal pores not distinguishable in my preparations.

The setæ (*v.* text-fig. 1) are in four bundles per segment, two ventral and two lateral; they are of the same character in all the bundles, being comparatively small with single blunt point, free extremity very slightly hooked, shaft straight or only curved in the slightest degree. They are arranged in fan-shaped form transversely in each bundle; those in the centre of each bundle are the smallest, and their size increases gradually towards the outermost components of the bundle, these latter being thus the longest. Each bundle is thus typically made up of a number of pairs of setæ, the members of a pair being of the same size, situated one on each side, and separated by the interposition between them of the smaller setæ of the bundle. In cases where the bundle consists of an odd number of setæ it can often be seen that one pair is incomplete, owing to the dropping out of a seta on one side. The arrangement is that peculiar to the genus. The number of setæ per bundle varies; posteriorly there are commonly 4 to 6 or 7 laterally, and 6 or 7 ventrally; anteriorly there are often more, most frequently perhaps 7 laterally, and 8 ventrally; 9 and

FIG. 1.—A seta of *Fridericia stewarti*; *d.* = its distal end.

10 are also met with in the ventral bundles. The longest setæ are about ·08 mm. in length.

The alimentary canal (fig. 1) begins as a narrow passage in segments i and ii ; the pharynx occupies iii, having dorsally a marked thickening of its wall from which muscular bands radiate to be attached to the body-wall. The œsophageal glands, three or probably four pairs, are present in segments v, vi and vii ; these are rounded or pear-shaped masses, not branched, attached to the alimentary tube, and also by strands to the body-wall ; the most posterior are the largest. They are composed of large rounded cells which appear to be comparatively loosely connected together ; the loose connection of the cells is also seen in sections.

Surrounding the alimentary tube in segment viii is a spherical structure (fig. 1, *ch.*) through which the tube is continued uninterruptedly ; this structure is itself hollow, its cavity being divided up by a number of septa ; its walls are fairly thick and apparently somewhat similar in character to those of the alimentary tube ; the structure is clothed externally by low peritoneal cells. In a series of (more or less) horizontal sections there appear two lateral dorsalward extensions of this chambered structure, which embrace between them in the middle line what is apparently the thin-walled dorsal vessel containing coagulated blood ; the dorsal vessel appears to communicate with the sinuses of the chambered structure.

There appear (in sections) to be fairly definite blood-sinuses surrounding the alimentary tube, between the tube and the peritoneal cell layer, in segments ix and x ; the sinus in x contains coagulated blood. Further back, behind the genital region, in segments xiii and posteriorly, there is also a fairly well-marked peri-intestinal space, though less definite perhaps than anteriorly in segments ix and x, and possibly of artificial origin.

There is no demarcation between œsophagus and intestine. The peritoneal cells around the tube are very tall in segments ix and x, and again behind the genital region to the posterior end of the body.

The lymph-corpuscles (fig. 2) are mostly oval, with rather sharp ends ; some are round or somewhat irregular in shape. Both kinds are granular ; a faint round vesicular nucleus with a nucleolar spot can be distinguished in them. The blood was apparently colourless ; the distribution of the blood-vessels is unfortunately not recognizable.

The nephridia consist of anteseptal and postseptal portions, the anteseptal being, according to the appearances shown by horizontal sections, about half as thick and two-thirds as long as the postseptal ; it projects forwards into the anterior segment, while the postseptal, appearing as a thick granular mass of oval shape, passes outwards and backwards to open externally in front of the level of the setæ.

The cerebral ganglion is situated in segment i ; its shape is difficult to make out ; it is apparently more deeply indented in

front than behind. The ventral nerve-cord is formed in the second segment by the union of the commissures.

I am unfortunately unable to give a description of the male organs from the specimens at my disposal ; and with regard to the female organs also the account must for the present be incomplete. Clusters of developing spermatozoa (few only) were seen in segment x ; clusters of ova in xi and posteriorly, some even at the extreme posterior end of the animal ; there are thus apparently (as is usual in the family) no egg-sacs formed. Somewhat opaque masses of yolk-matter, in small granules, occupy the clitellar region and part of segment xi. A genital gland, presumably testis, appears attached to the posterior face of septum 10-11.

The spermathecæ (fig. 1, *sp.*) are situated in segment v, opening anteriorly ventro-laterally between iv and v. They are tubular, with narrow lumen, of a much elongated pear-shape, the broader part being anterior. They have thick walls ; the passage of communication with the exterior is short and narrow ; they are attached behind to the dorsal wall of the alimentary canal, but I have not been able satisfactorily to demonstrate a continuity of the lumen of the spermatheca with that of the œsophagus ; such may, however, possibly exist.

The clitellum is seen in sections to consist of two kinds of cells intermingled ; of these some are quite clear, and others granular in appearance. The same distinction is also evident in a superficial view of the whole surface of the clitellum, the clear and granular cells appearing as clear and granular areas.

Systematic position.—The arrangement of the setæ described above is peculiar to the genus *Fridericia.* Of the species of this genus, the larger number present diverticula in connection with the spermathecæ; and of those (*F. alpina, alba, bulbosa* and *striata*, according to Michaelsen, "Oligochæta" in *Das Tierreich*, 1900) which have no such diverticula, *F. striata* is the only one which presents anything like so large a number of individual setæ in each bundle. In this form, however, the salivary glands are branched at the extremity, the ampullæ of the spermathecæ are bulbous in shape, and in connection with the passage to the exterior are two somewhat spherical glands ; these characters are absent in the present species.

Though the above account of the present form is incomplete, it would nevertheless appear to be distinguishable by several well-marked characters from the other members of the genus : and since I think the description will allow of its being recognized when next met with, I have ventured to distinguish it by the specific name *stewarti.* I have placed a type specimen, in balsam, in the Indian Museum, Calcutta, and also a series of longitudinal sections ; the specimen mounted whole shows the characters of the spermathecæ distinctly, and has ten setæ in one of the ventral bundles of the sixth segment.

Limnodrilus sp. (?).

No. 13. Te-ring Gompa, Tibet ; 14,000 ft. ; 22-i-07.
A single imperfect specimen, immature sexually.

No. 15. Te-ring Gompa, Tibet ; 14,000 ft. ; 22-i-07.
Eleven specimens, mature and immature.

No. 18. Te-ring Gompa, Tibet ; 14,000 ft. ; 22-ii-07.
Two specimens with some fragments ; some showing sexual organs.

No. 33. High Hill Gompa, Gyantse, Tibet ; 14,500 ft. ; 28-iii-07.
Two specimens, with two fragments of anterior end ; sexually mature.

No. 40. Te-ring Gompa, Tibet ; 14,000 ft. ; 14-iv-07.
Ten specimens, some with sexual organs.

No. 54. High Hill Gompa, Gyantse, Tibet ; 14,500 ft. ; 8-vii-07.
Eight specimens, some with sexual organs.

No. 57. High Hill Gompa, Gyantse, Tibet ; 14,500 ft. ; 10-vii-07.
Six specimens, some with sexual organs.

I cannot separate the above, taken at various times at two places in the neighbourhood of Gyantse. The specimens were on the whole well preserved ; several batches were stained a deep brown, probably from the fixing agent employed, and these did not stain well nor give good sections ; the setæ of all the batches were very much broken.

Length frequently about 8 mm., specimens up to 20 mm. were met with. Diameter to ·4 mm. Segments 40—64. Clitellum on segments xi and xii primarily, spreading to x and xiii and even encroaching a little on ix. Prostomium well marked, bluntly conical, marked off by a distinct groove ; external annulation distinct, double in the anterior segments according to sketches by Capt. Stewart from life ; this double character is recognizable, though apparently somewhat less distinct, in the preserved specimens also.

FIG. 2.—Seta of *Limnodrilus* sp. (?).

Setæ dorsal and ventral of same character throughout (*v.* text-fig. 2), both series beginning in segment ii ; they have the usual $\int$-shaped curve, are bifid distally, both prongs being of about the same length, the distal prong slenderer than the proximal ; nodulus indistinct, as a slight swelling at the junction of middle and distal thirds, just within the body-wall ; length of setæ about ·08 mm., but variable ; number in bundle usually 4—6, occasionally 7.

The alimentary tube is narrow in segments i, ii ; pharynx in iii ; œsophagus extends to ix, and the tube expands in x to form the intestine, if genital products are not present to compress it.

There is nothing that can be called a stomach ; the intestine is constricted at the septa, and bulges between the septa ; its epithelium is columnar; the tube is covered externally by roundish, slightly staining granular peritoneal cells, which may be so numerous in places as to obliterate the body-cavity.

Besides these peritoneal cells, there are body-cavity corpuscles of circular shape, nucleated, very coarsely granular, the granules appearing as highly refractive particles similar to those in some species of *Nais*.

The circulatory system is not sufficiently distinct for description ; the same may be said of the nephridia. The cerebral ganglion is in segment i, not in the prostomium, and the nerve-cord has the usual relations.

The testes (fig. 4, *te.*) are in segment x, along with the spermathecæ ; the funnel (fig. 4, *f.*), also in x, is large, regular in shape, sessile on the septum ; the vas deferens (fig. 4, *v.d.*), whose walls are composed of a layer of somewhat cubical cells, passes backwards in xi, presenting itself as a fairly stout tube, with perhaps a gentle curve or two, but not coiled in any way ; a single longitudinal section will sometimes cut nearly the whole length of the tube ; probably in the extended condition of the animal it was almost straight. It opens into the atrium at the inner end of the latter. The atrium (figs. 3, 4, *atr.*), in segment xi, is a somewhat pear-shaped chamber, its broader end being internal ; it is prolonged into the penis (figs. 3, 4, *pen.*), a short and somewhat inconspicuous structure, whose chitinous sheath also is hardly to be made out in my preparations. The prostate (figs. 3, 4, *prst.*) is a well-marked mass of cells surrounding the inner end of the atrium on all sides.

The spermathecæ (fig. 3, *sp.*) are in segment x, not extending beyond this segment ; they may be bilobed or not, or that of one side may be bilobed, the other spherical. The lining epithelium is much elongated near the external aperture, and some of these elongated cells show clear spaces in their substance ; the same condition of the epithelium is seen over the projection of the wall into the cavity of the spermatheca where this organ is bilobed. A hyaline non-staining material fills the spermathecæ, aggregated frequently into oval or elongated masses (? spermatophores).

The ovaries (fig. 3, *ovy.*) are in segment xi, in close connection with the vas deferens of each side. I have not identified the oviducts.

The genital sacs (sperm-sac and ovisac) are large ; the male products may extend forwards as a well-marked rounded mass into segment ix. The combined sacs extend backwards through a large number of segments, often to xviii, and even to xxv. The male products are the more conspicuous and usually more bulky ; the female products, ova with granular yolk, are usually posterior, though they may have sperm-morulæ behind as well as in front of them.

In a few specimens the ventral setæ of segment xi are

modified (genital setæ), the prongs of the distal end being much shorter, and the nodulus more distinct (*v.* text-fig. 3).

FIG. 3.—Genital setæ of *Limnodrilus* sp. (?); by the side of the fully-formed seta is a young one in process of formation: compare with text-fig. 2.

Of the three genera of Tubificidæ which possess only forked setæ in the dorsal as well as in the ventral bundles,—*Limnodrilus*, *Clitellio* and *Vermiculus*,—the two latter are immediately excluded by the characters of their genital apparatus, since *Vermiculus* possesses single male and spermathecal pores, and *Clitellio* has no prostate. It seems probable that the present form is a *Limnodrilus* and that the differences from the usual descriptions of that genus are, in part at least, due to the fact that the examination has been made on preserved material. A few points may, however, be further mentioned.

One would not expect the integumental blood-vessels, which form one of the characteristics of *Limnodrilus*, to be recognizable in preserved specimens; but I am a little surprised that the "hearts" of segment viii, or viii and ix, give so little evidence of their existence; they are immediately visible, for example, in preparations of a small *Limnodrilus* from Lahore (species undetermined, as I have not yet met with mature specimens), in which also the main vessels can be followed with ease; this is by no means the case with the Tibet specimens. It is to be remembered, however, that the "hearts" need not be specially enlarged vessels; their contractility is their special characteristic.

The vas deferens, again, is in *Limnodrilus* distinguished by its great length, and by being narrow and much coiled (Beddard, *Oligochæta*, p. 249). This cannot be said of the present form, in which it is comparatively short and stout, and is not coiled: and this difference does not seem to be due to the fact of the animals being examined in the preserved state.

I have not been able to observe the character of the spermatophores mentioned by Beddard, namely that the free ends of the spermatozoa form a spiral on the outer surface.

Admitting, however, this form to a place in the genus *Limnodrilus*, the species must, I fear, remain undetermined; the discrimination of the various species depends largely on the characters of the penis and its sheath, and to some extent also on the shape of the brain,—organs of which unfortunately I can only give incomplete descriptions. I may refer to Beddard's words (p. 251, *op. cit.*), referring to the occurrence of the genus in Hawaii: "I cannot distinguish any marked peculiarities which justify me in giving it a new name, though on the other hand I have not yet identified it with any of the known forms. Living material is essential for the proper description of these Tubificids."

REPORT ON A SMALL COLLECTION OF FRESHWATER MOLLUSCA (*LIMNÆA* AND *PISIDIUM*) FROM TIBET.

By H. B. PRESTON, *F.Z.S.*

The Mollusca dealt with in the present paper were recently collected by Captain F. H. Stewart of the Indian Medical Service at high altitudes in Tibet, and were placed in my hands for identification by Dr. N. Annandale, Superintendent of the Indian Museum, Calcutta.

Though there are a good number of specimens, only three species appear to be represented, all belonging to the genera *Limnæa* and *Pisidium*, and I would take this opportunity of tendering my thanks to the Rev. E. W. Bowell and Mr. B. B. Woodward, who have kindly assisted me in working at these difficult groups.

Limnæa hookeri, Reeve.

From the following localities: Gyantse, 13,120 feet, in a pond which dries up in winter, two lots, adult and young; Mangtsa, 14,500 feet, in a stream from a warm spring which only freezes during the coldest months (February and March; during the rest of the winter there is only a little ice at the edge), two lots, adult and young; Se-chen, 13,100 feet, in marshy pools, a number of specimens, mostly adult;—large quantities of spawn were observed under stones in this locality.

Though the shells vary somewhat in size and form, I am quite able with the series before me to link them all up into the present species.

With regard to the soft parts: Mr. Bowell reports that the genitalia are very similar to those of the common European form *L. auricularia*, Lin. The vas deferens is, however, markedly shorter, and the radula is remarkable for the length of the cusps and their subulate appearance, and also for there being no great distinction in type between the laterals and marginals.

Limnæa bowelli, sp. nov.

Shell rimate, acuminately ovate, rather solid, polished, shining, pale yellowish horn colour; whorls 4, shouldered above, marked with rather coarse lines of growth; sutures deeply impressed; columella descending obliquely and diffused above into a thick callus which joins the upper margin of the peristome; peristome simple; aperture ovately, inversely auriform.

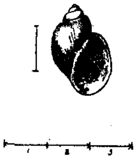


FIG. 1.—*Limnæa bowelli*, Preston.

Altitude	..	..	.. 8·5 mm.
Diam., major		..	.. 5·25 ,,
Aperture, alt.		..	.. 5 ,,
,, diam.		..	.. 3·75 ,,

Mr. Bowell informs me that the radula bears a strong resemblance to that of *L. glabra*, Müll., but has fewer laterals, the general appearance being more suggestive of the radula of a *Planorbis* than that of a *Limnæa*; the maxilla is also very remark-

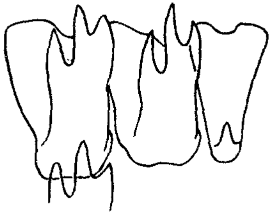


FIG. 2.—Radula of *Limnæa bowelli*, Preston.

able, with a large blunt beak arising from the centre of the semicircular piece, and he goes so far as to suggest that this last character might possibly form the basis of a new genus.

Habitat—Te-ring Gompa, in a small hill stream arising from a spring, 14,000 feet (this stream does not freeze in winter); also from Mang-tsa, 14,500 feet; High Hill Gompa, Gyantse valley, in a small hill stream, among moss and stones, 14,500 feet; and Gyantse, 13,120 feet.

Pisidium stewarti, sp. nov.

Shell sub-trigonal, rather inflated, pale yellowish horn colour, marked with fine concentric lines of growth; umboes large; anterior lateral teeth somewhat curved with broad groove between, posterior lateral teeth long and straight; cardinal teeth broad and somewhat projecting in right, strong and sharply curved in left valve.

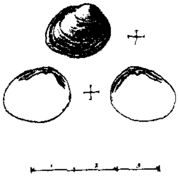


FIG. 3.—*Pisidium stewarti*, Preston.

Long.	..	..	2·25 mm.
Lat.	..	..	3 ,,

Habitat—High Hill Gompa, Gyantse valley, in a small hill stream, among moss and stones, 14,500 feet (two specimens only).

Mr. B. B. Woodward, who very kindly examined this species, tells me that he has seen no recent form resembling it, its nearest ally being a fossil from the tertiary deposits of Belgium which, I understand, still awaits description.

NOTE SUR LES PLANORBES RECUEILLIS PAR LE CAPITAINE F. H. STEWART EN TIBET.

Par LOUIS GERMAIN.

Au cours de son voyage dans les montagnes du Tibet, M. le Capitaine F. H. STEWART a recueilli une interessante collection de Mollusques. M. N. ANNANDALE, Superintendant du Musée Indien, a eu l'aimabilité de me confier l'ètude des Planorbes. Je suis heureux de l'en remercier ici.

Les récoltes de M. F. H. STEWART, bien que peu nombreuses, renferment cependant des espèces rares et même un Planorbe nouveau.

Planorbis saigonensis, Crosse et Fischer.

1834. *Planorbis*, No. 12, HUTTON, Journ. Asiatic Society of Bengal, iii, p. 91.

1834. *Planorbis compressus*, HUTTON, *ibid.*, iii, p. 93 (*non* MICHAUD).

1836. *Planorbis compressus*, BENSON, *ibid.*, v, p. 743, No. 21.

1844. *Planorbis Tondanensis*, MOUSSON, *Land- und Süsswasser Mollusken von Java*, p. 44, Taf. v, fig. 4 (*non* QUOY et GAIMARD).

1863. *Planorbis saigonensis*, CROSSE et FISCHER, *Journal de Conchyliol.*, xi, p. 362, pl. xiii, fig. 7.

1867. *Planorbis compressus*, VON MARTENS, *Malakozool. Blätter*, xiv, p. 213.

1875. *Planorbis compressus*, MORELET, *Séries Conchyliologiques*, iv, Indo-Chine, p. 276.

1878. *Planorbis compressus*, SOWERBY, Monogr. of *Planorbis*, *in* REEVE, *Conch. Iconica*, xx, sp. 118, pl. xiv.

1881. *Planorbis confusus*, DE ROCHEBRUNE, *Bullet. Soc. Philomat. Paris*, p. 32.

1886. *Planorbis compressus*, CLESSIN, Die Familie der Limnaeiden *in* MARTINI und CHEMNITZ, *System. Conchyl. Cabinet*, xvii, p. 107, No. 71, Taf. xvii, fig. 10 [indiqué, par erreur, Taf. xvi, dans le texte].

1886. *Planorbis saigonensis*, CLESSIN, *ibid.*, p. 191, Taf. xxix, fig. 3.

1904. *Planorbis saigonensis*, H. FISCHER et DAUTZENBERG, Catalogue Moll. Indo-Chine, *in Mission Pavie*, p. 414 (tiré à part, p. 44).

1904. *Planorbis confusus*, H. FISCHER et DAUTZENBERG, *ibid.*, p. 414.

1905. *Planorbis saigonensis*, DAUTZENBERG et H. FISCHER, *Journ. de Conchyliologie*, liii, p. 117.

Cette espèce est certainement voisine du *Planorbis thibeticus* décrit par DESHAYES en 1870.[1] Cependant les exemplaires du Muséum de Paris, sur lesquels DESHAYES a décrit son espèce, diffèrent du *Planorbis saigonensis* par leur forme plus convexe en dessus, par leur dernier tour plus nettement caréné, par leur ouverture plus allongée transversalement, et, généralement, par leur test plus mince, pellucide.

Ainsi que l'a fait remarquer A. MORELET,[2] le *Planorbis saigonensis*, Crosse et Fischer, est le jeune âge du *Planorbis compressus*, Hutton. Ce dernier nom ayant été antérieurement donné à un Planorbe de la faune française,[3] MM. DAUTZENBERG et H. FISCHER [4] ont, avec raison, adopté le vocable de *saigonensis* pour désigner, sans confusion possible, l'espèce tout d'abord décrite par HUTTON.

Le *Planorbis saigonensis* a une aire de dispersion considerable. Il vit, non seulement dans une grande partie de l'Asie orientale, mais encore au Japon (variété *japonicus*, von Martens[5]) et dans les îles de la Sonde. C'est à une variété, habitant l'île de Java, que MOUSSON [6] a donné le nom de *Planorbis tondanensis*, confondant ainsi deux espèces bien diffèrentes. Le vèritable *Planorbis tondanensis*, décrit par QUOY et GAIMARD,[7] diffère, eu effet, du *Planorbis saigonensis* : par sa spire à croissance plus rapide ; par son dernier tour plus dilaté, à carène très émoussée, à peine sensible ; par sa surface inférieure plus étroitemeut et plus profondément ombiliquée ; par son ouverture plus oblique, moins anguleuse, presentant un fort encrassement submarginal simulant un bourrelet blanchâtre ; enfin par ses bords marginaux très convergents, reunis par une callosité blanche.[8] Ces deux derniers caractères sont parfaitement rendus dans les figures de cette espèce données par le Dr. W. KOBELT.[9]

Gyantse (Tibet), à 13,120 pieds, dans une mare dessêchée pendaut l'été ; 10 Septembre, 1907 [No. 90].

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1 DESHAYES (G. P.). Diagnoses d'espèces nouvelles de Mollusques terrestres et fluviatiles de la principauté de Moupin, Thibet oriental, envoyées au Muséum d'hist. natur. de Paris par M. l'abbé Armand David, *Bulletin des Nouvelles Archives du Muséum*, vi, 1870, p. 27. [*Planorbis thibetanus.*]

2 MORELET (A.). *Séries Conchyliologiques*, etc., iv Livraison ; *Indo-Chine* ; 1875 ; p. 276.

3 MICHAUD (G.). *Complément à l'hist. natur. des Mollusques terr. et fluv. de France, par Draparnaud* ; 1831, p. 31, pl. xvi, figs. 6—8.

4 DAUTZENBERG (PH.) et FISCHER (H.). Liste des Mollusques recoltés par M. le cap. de fregate BLAISE au Tonkin et description d'espèces nouvelles ; *Journal de Conchyliologie* ; liii, 1905, p. 118.

5 MARTENS (Dr. E. von). Ueber die ostasiatischen Limnaeacens ; *Malakoz. Blätter* ; xiv, 1867, p. 214.

6 MOUSSON (ALBERT). *Die Land- und Süsswasser Mollusken von Java* ; 1849, p. 44, Taf. v, fig. 4.

7 QUOY et GAIMARD. *Voyage de découvertes de l'Astrolabe* ; *Zoologie* ; t. ii, 1833, p. 209 ; Atlas, pl. lviii, fig. 39.

8 Je donne ces caractère d'après le *type figuré*, qui appartient aux collections du Muséum d'histoire naturelle de Paris. Son test, un peu brillant, assez solide, est d'un jaune légèrement rougeâtre ; il présente des stries très fines, bien régulières, un peu serrées, à peine plus fortes aux environs de l'ouverture, plus apparentes en dessus qu'en dessous.

9 KOBELT (Dr. W.). Land- und Süsswasserkonchylien ; *Abhandl. der Senckenb. naturforsch. Gesellsch.*, Frankfurt ; Bd. xxiv, 1897, p. 82, Taf. xi, fig. 3.

Te-ring Gompa (Tibet), à 14,000 pieds; 26 Avril, 1907 [No. 43]

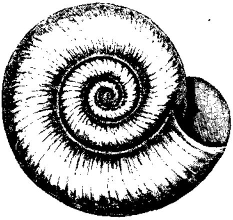
Mang-tsa (Tibet), à 14,500 pieds, dans un lac non gelée en hiver; Juillet 1907 [No. 65].

Planorbis stewarti, Germain, sp. nov.

Coquille légèrement bombée en dessus, largement et très profondément ombiliquée en dessous; spire composée de 4½ tours à croissance régulière et médiocrement rapide; dernier tour médiocre, notablement plus bombé dessous que dessus, un peu descendant à son e trémité, nettement arrondi; sutures bien manquées; ouverture oblique, ovalaire-arrondie, à bords très convergents.

Diamètre maximum, 4¾ millimètres; diamètre minimum, 3¾ millimètres; épaisseur maximum 1½ millimètres.

Test solide, un peu épais, brillant, d'un jaune ambré un peu grisâtre, orné en dessus de stries très fines, très serrées, assez irrégulières, bien obliques et légèrement onduluses. En dessus les stries, également serrées et irrégulières, sont plus finement marquées.



Planorbis stewarti, Germain, sp. nov.

Cette belle espèce, que je suis heureux de dédier au Capit. F. H. STEWART, rappelle, par sa forme, le *Planorbis sibericus*, Dunker, var. *major*, von Martens.[1] Mais il est surtout voisin du *Planorbis saigonensis*, Crosse et Fischer, dont on le séparera: par sa coquille plus bombée en dessus et beaucoup plus profondement ombiliquée en dessous; par sa spire à croissance plus régulière; par son dernier tour biens moins grand proportionellement, et nettement arrondi; par ses sutures plus profondes; enfin par son ouverture plus ovalaire-arrondie, à bords plus rapprochés.

Rham-Tso (Tibet), à 14,700 pieds, dans les herbes d'un lac, avec le *Planorbis himalayaensis*, Hutton; 12 Août, 1907 [No. 76].

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1 MARTENS (Dr. E. von). Über centralasiatische Mollusken, *Memoires de l'Académie impér. sciences Saint-Petersbourg*, xxx, No. 11, 1882, p. 43, Taf. iv, figs. 13*a*, 13*b*, 13*c*.

Planorbis himalayaensis, Hutton.

1886. *Planorbis himalayaensis*, HUTTON, *in* CLESSIN, Die Familie der Limnaeiden ; *in* MARTINI und CHEMNITZ, *System. Conch. Cabinet*, xvii, p. 141, No. 118, Taf. xx, fig. 8.

Les exemplaires recueillies par le Capit. F. H. STEWART correspondent bien à la description et à la figuration de CLESSIN ; ils sont seulement de taille plus faible, leur diamètre maximum n'atteignant que 4 millimètres.[1] Le test, relativement solide, est mince, d'un jaune ambré clair, orné de stries assez arquées, plus serrées et plus fortes en dessous qu'en dessus.

Cette espèce presente d'etroits rapports avec le *Planorbis nanus*, Benson,[2] et il est fort possible que la possession de materiaux suffisants conduise à la reunion de ces deux coquilles.

Te-ring Gompa (Tibet), à 14,000 pieds, près de la source de la rivière ; 15 Juillet, 1907.

High Hill Gompa, Gyantse (Tibet), à 14,500 pieds, sous les pierres et les herbes aquatiques d'un rivière ; 10 Juillet, 1907 [No. 58].

Rham-Tso (Tibet), à 14,700 pieds, dans les herbes d'un lac d'environ 10 mile de long sur 6 de large ; 12 Août, 1907 [Nos. 575 et 76].

Planorbis barrakporensis, Clessin.

1886. *Planorbis Barrakporensis*, CLESSIN, Die Familie der Limnaeiden, *in* MARTINI und CHEMNITZ, *System. Conchyl. Cabinet*, xvii, p. 125, Taf. xvii, fig. 7.

Les exemplaires de cette espèce recueillis au Tibet ont un test assez clair, ambré un peu fauve, plus brillant dessous que dessus, peu épais, orné de stries fines, serrées, bien obliques, moins accusées dessous.

Le *Planorbis huttoni*, Benson,[3] n'est qu'une variété de cette espèce se distinguant du type par son enroulement plus rapide, son dernier tour plus dilaté, plus arrondi, un peu descendant à son extrémité, enfin par son ouverture plus ovalaire.

Mang-tsa (Tibet), à 14,500 pieds, dans les herbes d'un étang qui n'est pas gelé en été ; 2 Juillet, 1907 [No. 52].

Gyantse (Tibet), à 13,120 pieds ; 5 Decembre, 1906 [No. 4].

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[1] La type de CLESSIN mesure 5½ millimètres de diamètre maximum. Il provient de Tinjori Valley, Inde.

[2] BENSON, *Proceed. Zoolog. Society, London*, 1856, p. 186. Ce Planorbe a été figuré par SOWERBY, Monograph of the genus *Planorbis*, *in* REEVE, *Conch. Iconica* xx, 1878, sp. 75, pl. ix, figs. 75*a*—75*b*.

[3] BENSON *in* CLESSIN, *loc. supra citat.*, xvii, 1886, p. 139, Taf. xviii, fig. 4.

COMPARISON OF THE FISH FAUNA OF THE NORTH AND THE SOUTH FACES OF THE GREAT HIMALAYAN RANGE.[1]

By F. H. STEWART, *M.A., D.Sc., M.B., Captain, I.M.S.*

In the area of the "North face of the Great Himalayan Range" it is intended to include not only the north face of the great range proper, but the whole area bonnded on the south by the crest of the Himalayas, and on the north by the Karakorum range and its continuation eastward. This area is composed of the Trans-Himalayan portions of the catchment-areas of the Brahmaputra on the east and of the Indus on the west, with the Mansarowar and the Trans-Himalayan Sutlej areas lying in the centre. It extends through twenty degrees of longitude and has an area of about 203,000 sq. miles.

As far as our present subject is concerned the principal physical characteristics of this region are—

1. Its great elevation above sea-level (Chaksam ferry on the Brahmaputra, longitude 90° 45′ E., 11,550 feet; Rham-Tso, near the crest of the range, 89° 30′ E., 14,700 feet; Shigatse on the Brahmaputra, 89° E., 12,800 feet; sources of the Brahmaputra, between 82° and 83° E., 16,000 feet; Lake Mansarowar, 81° E., 14,900 feet; Gartok on the sources of the Indus, 80° 25′ E., 15,100 feet; Leh on the Indus, 78° E., 11,300 feet; Indus at Skardo, 75° 30′ E., 8,900 feet).
2. Its very low rainfall. The greater portion of the water appears to be derived from springs.
3. The very sparse vegetation.
4. The rapidity of flow of the streams.

The south face of the great chain on the other hand includes the catchment-areas of the Manas, Raidak, Tista, Kosi, Baghmati, Rapti, Karnali, Kali, Ramganga, Ganges, Jumna, Beas, Ravi, Chenab and Jhelum, and the Cis-Himalayan portions of the areas of the Brahmaputra, Sutlej and Indus.

In regard to the elevation of this area from the zoologist's point of view, it must be remembered that most specimens have been taken from rivers running in the depths of the valleys at probably not more than 3—4,000 feet above sea-level.

In contrast to the uorth face the south face is, of course, a region of heavy rainfall and abundant vegetation.

It should be noted that the crest of the Himalayan range does not correspond with the watershed, but that the former lies considerably to the south of the latter. As will be pointed out below, we have at present no data which would enable us to decide which of these two lines forms the zoological boundary between the two regions.

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[1] For the geograpbical facts in this note I am chiefly indebted to Burrard and Hayden [2].

The records of fish obtained from the northern area are, of course, still somewhat scanty. They are to be found in the *Fauna of British India* (comprising fish from Leh and Ladak), Tate Regan's reports on the fish collected during the Tibet mission, and Lloyd's report in the present series.

From the northern area seventeen species of fish are at present known, belonging to the families Siluridæ and Cyprinidæ.[1] From the southern area thirty-six species of these two families are recorded in the *Fauna of British India.* These two groups have only two species in common (*Schizothorax esocinus* and *Diptychus maculatus*). (These two species are also the only forms from the Trans-Himalayan Indus which have not hitherto been found in the Trans-Himalayan Brahmaputra. Thus there are no species common to the latter and to the rivers of the south face of the Himalayas.) Thus of these two families there are fifteen species confined to the northern region, thirty-four to the southern, and two are found in both.

The separation of the two groups may be chiefly due to (1) a physical obstacle separating the two water-systems and preventing the passage of fish from one system to another, or (2) some difference in the biological environment in the two systems.

(1) It would appear that the importance of a watershed as a barrier might be very easily exaggerated. The Tang-la is the watershed between the Nyang-chu, which runs into the Brahmaputra, and the Amu-chu, which runs into the Raidak. With a height of 15,200 feet it might be expected to form a fairly efficient obstacle. We find, however, that the streams on the two sides of the pass are separated by a distance of at the most one mile, and that this mile consists, not of abrupt cliffs, but of gently sloping open ground. In the rainy season the smallest rivulets doubtless approach each other much more closely. To the north of the Tang-la a series of rivulets and marshes extends throughout the twenty miles which separate the pass from the Rham-Tso. Such a watershed is not likely to prove a more efficient barrier in its purely physical aspect, than, for instance, the watershed separating the Clyde and the Tweed.

In this connection it may be noticed that the young of these river fish are extremely fond of intruding themselves into the smallest and shallowest streams.

(2) With no further data than those at present at our disposal, it is not possible to discuss differences in biological surroundings

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[1] Salmonidæ are not known from the basins of either the Indus or Brahmaputra. In the collections of the Indian Museum are specimens of a *Salmo* which have been identified by Tate Regan as *S. oxianus*, Kessler. Tate Regan considers this species to be only doubtfully distinct from *S. fario*, the common British brook trout. These specimens come from (1) the Koksha river, Zila, Chitral, at a height of 8,000 feet above sea-level, and (2) from small tributaries of the Bammian river in Northern Afghanistan at a height of 10,000 feet. Both the Koksha and Bammian rivers run northward into the Oxus.

These are the two points at which the Salmonidæ approach most closely to the rivers of the Himalayas.

between the two regions. One fact may, however, be worth recording, namely, the remarkable quantity of mud and decomposable organic matter suspended in the water of the Nyang-chu. Water placed in a bottle deposited a considerable layer of mud, and if allowed to stand for more than a day, began to give off a most objectionable odour.

It is much regretted that no collections were made from streams to the south of the Tang-la, especially in the plains of Phari and Ling-matang, where the character of the surroundings is still largely Tibetan. As far as I am aware no collections have ever been made from the rivers of the south face of the Himalayas near their sources between the watershed and the crest of the range. It is, therefore, not possible to say with which of these two lines the line of separation of the faunas corresponds.

Dr. Annandale informs me that *Rana pleskii*, the only amphibian at present known from the provinces of Tsang and Ü, is not known to occur on the south face of the Himalayas. This animal, in addition to frequenting the marshes of the valleys, penetrates into the most minute streams on high and bare hillsides. A watershed would, therefore, be no obstacle to it.

LIST OF PAPERS REFERRED TO.

1. Boulenger, G. A. .. "On some Batrachians and Reptiles from Tibet," *Ann. Mag. Nat. Hist.* (7), vol. xv (1905), p. 378.

2. Burrard, S. G., and Hayden, H. H. *A sketch of the Geography and Geology of the Himalaya Mountains and Tibet*, Calcutta, 1907.

. Tate Regan, C. .. "Descriptions of five new Cyprinid fishes from Lhasa, Tibet," *Ann. Mag. Nat. Hist.* (7), vol. xv (1905), p. 185.

4. Tate Regan, C. .. "Descriptions of two new Cyprinid fishes from Tibet," *Ann. Mag. Nat. Hist.* (7), vol. xv (1905), p. 300.

EXPLANATION OF PLATE VIII.

FIG. 1.—Anterior portion of body of *Fridericia stewarti*. The clitellar region being somewhat opaque is shaded. Setal bundles of segments ii and iii alone represented. Numbering of segments indicated by small Roman numerals. The animal is seen a little obliquely, but mainly from the ventral side; semi-diagrammatic.

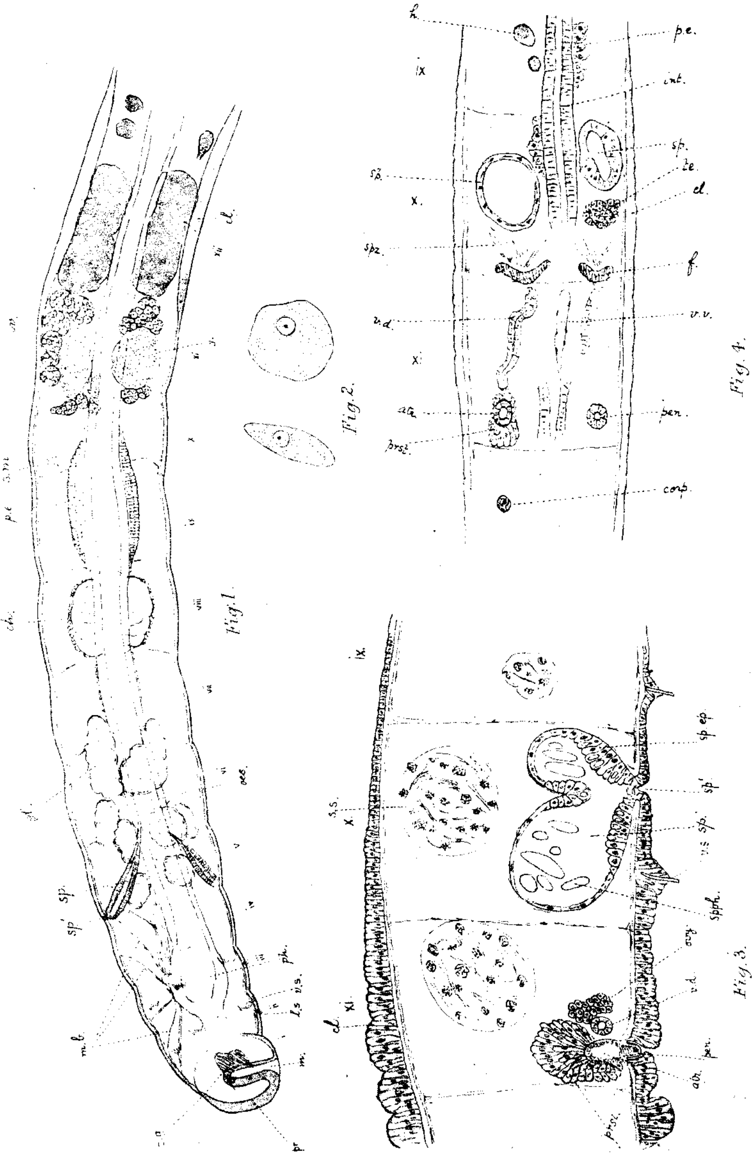
C.g., cerebral ganglion; *ch.*, chambered body surrounding alimentary canal in segment viii; *cl.*, clitellar epithelium; *gl.*, œsophageal glands; *l.s.*, lateral setal bundle; *m.*, mouth; *m.b.*, muscular bands attaching pharynx to body-wall; *oes.*, œsophagus; *ov.*, masses of ova; *p.e.*, peritoneal epithelium, here (segm. ix) markedly elongated where it surrounds the alimentary tube; *ph.*, pharynx; *pr.*, prostomium; *s.m.*, sperm-morula; *sp.*, spermatheca; *sp'.*, its external opening; *v.s.*, ventral setal bundle; *y.*, yolk mass.

FIG. 2.—Lymph corpuscles of *Fridericia stewarti*.

FIG. 3.—Longitudinal section of segments x, xi of *Limnodrilus* sp. (?). The testis, main part of vas deferens, and seminal funnel do not happen to be cut; these are shown in the next figure.

Atr., atrium; *corp.*, lymph corpuscle; *f.*, funnel; *h.*, "heart" (?); *ovy.*, ovary; *pen.*, penis; *prst.*, prostate; *sp.ep.*, tall epithelium at base of spermatheca; *spph.*, spermatophore; *spz.*, spermatozoa entering funnel; *s.s.* sperm-sac; *te.*, testis; *v.d.*, vas deferens; *v.v.*, ventral vessel. Other references as in fig. 1.

FIG. 4.—Horizontal section of segments x, xi of *Limnodrilus* sp. (?) near the ventral surface. References as above.



TIBETAN OLIGOCHÆTES

IV. NOTE ON SOME AMPHIBIOUS COCKROACHES.

By R. SHELFORD, *M.A.*, *F.L.S.*

Early in 1908, Dr. Nelson Annandale forwarded to me a tube of spirit containing four examples of cockroaches which he had found in a jungle stream in the Dawna Hills of Lower Burma and asked me to report on them. Three of the specimens are larval forms of a species of *Epilampra*, and the fourth is an adult winged male, also of the genus *Epilampra* and apparently new to science. Dr. Annandale, in a letter to me on the subject of these cockroaches, writes :—" The wingless specimens were under stones in a small jungle stream and behaved just as the one I obtained in Chota Nagpur did.[1] The winged specimen was under a stone at the edge of the stream, but swam readily when pursued. It did not seem so much at home in the water, however, and apparently could not, owing to its wings, raise the tip of its abdomen above the surface." The wingless specimens are male larvæ, and exhibit the same modifications for an amphibious life as I have described them in very similar larvæ from Borneo[2]; that is to say, the terminal abdominal spiracles are situated at the base of two tubes projecting from below the seventh abdominal tergites. I have nothing further to add to that account beyond stating that the genus *Rhicnoda* can be distinguished from *Epilampra* by the forward production of the pronotum which completely covers the head, whereas in *Epilampra* the vertex of the head is exposed ; adult males of *Rhicnoda* have not yet been recognised with certainty. It is quite evident that some species of *Epilampra* are amphibious in their early stages and probably all the species of *Rhicnoda* are amphibious throughout the whole of their life. At first I was inclined to believe that the larvæ sent me by Dr. Annandale were the young stages of the adult male, in spite of the different shape of the pronotum and the greater breadth of the abdomen in the larvæ, for we know that the larvæ of the species of *Gyna*, an African genus of cockroaches, differ from their adults just in these very characters. But after a careful examination I have come to the conclusion that Dr. Annandale's specimens constitute two distinct species. Mr. J. Mangan, in a paper " On the mouth-parts of some Blattidæ,"[3] has described some peculiar processes that occur on the inner edge of the lacinia of the maxilla. These processes sometimes afford valuable characters for discriminating

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1 *J. Asiat. Soc. Bengal* (N. S.), ii, pp. 105-106 (1906).
2 *Zoologist*, June 1907.
3 *Proc. R. Irish. Acad.*, xxvii, Sect. B, No. 1 (1908).

species; in closely allied species such as *Ectobius lapponicus*, L., and *E. perspicillaris*, Herbst, they appear to be identical, but though I have examined a considerable number of species, I have not yet found the processes to differ in structure in the same species at different stages in its life-history. Since these processes differ in the larvæ and in the adult submitted to me by Dr. Annandale (text-figs. 1 and 2), I am consequently of opinion

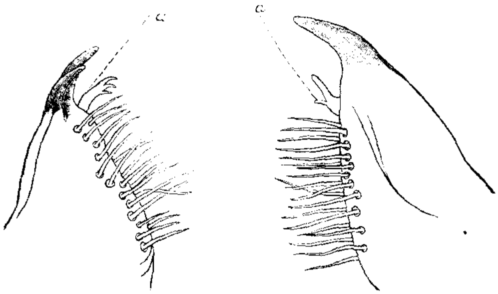

FIG. 1. FIG. 2.

FIG. 1.—Right lacinia of *Epilampra annandalei*, ♂, inner aspect, × 100.
,, 2.—Right lacinia of *Epilampra* sp., larva, outer aspect, × 100.
a = process of lacinia.

NOTE.—The bifid tip of the lacinia shown in fig. 2 is hidden beneath the large outer tooth.

Drawn with the camera lucida.

that the larvæ and adult must be referred to two quite distinct species. The adult exhibits no modifications whatever for an aquatic or amphibious life, the legs are not adapted for swimming and there is no sign of spiracular tubes projecting from beneath the seventh abdominal tergites as in the larvæ. As the tegmina and wings project beyond and cover the tip of the abdomen, the cockroach would not be able to rest below the surface of the water and at the same time draw in its air-supply through the terminal spiracles as can the larvæ, and I very much doubt if it can even swim below the surface of the water. Dr. Annandale's remarks in another letter to me on the swimming habits of this cockroach are worth quoting here:—"The cockroaches were collected on a very hurried trip and I had little opportunity to study them. I am sure, however, that the winged form could only swim on the surface. It took to the water as most, or at any rate very many, of the smaller Indian Orthoptera will, if hard pressed. This is true of most Acridiids and many smaller Locustids and I think of nearly all crickets and many cockroaches, though perhaps to a less extent in the cockroaches....Many Indian cockroaches, especially

Epilampridæ, live in damp places near the edge of jungle streams and do not mind getting wet. It is astonishing what a large proportion of insects can swim well if they are forced to do so, and I think that in India there is a very marked tendency for members of terrestrial groups of all kinds to become aquatic or amphibious.'' From observations in Borneo I can confirm Dr. Annandale's remarks, for I have frequently seen species of *Tettix* (*s. l.*) and *Tryxalides* take to the water when disturbed.

I have much pleasure in naming the new species after its discoverer.

Epilampra annandalei, sp. nov.

♂. Rufo-castaneous. Vertex of head freely exposed, finely dotted with fuscous; eyes wide apart. Pronotum trapezoidal, posteriorly produced obtusely, finely dotted with fuscous, smooth, litid. Tegmina exceeding the apex of the abdomen, unicolorons, impunctate. Wings with marginal area flavous, ulnar vein with fifteen rami, four being complete. Abdomen rufo-testaceous, supra-anal lamina produced, subquadrate, apex slightly emarginate, subgenital lamina rather large, produced, slightly asymmetrical, with two slender styles. Cerci long, acuminate. Femora strongly armed: front femora armed on anterior margin beneath with seven spines succeeded distally by filiform setæ; four spines on posterior margin. Formula of apical spines, $\frac{2}{1}$, $\frac{1}{1}$, $\frac{1}{1}$. Posterior metatarsi very long, exceeding the remaining joints in length, completely bi-serrulate beneath, second tarsal joint also armed beneath; all the pulvilli minute, apical.

Total length 20 mm.; length of body 12 mm.; length of tegmina 16 mm.; prouotum 41 mm. × 5 mm.

This species belongs to the group characterised by the small size, impunctate pronotum and elongate metatarsi; its nearest allies are *E. fervida*, Walk., *E. quadrinotata*, Walk., *E. geminata*, Br., and *E. flavomarginata*, Shelf. The larvæ cannot be referred with certainty to any known species, since we are almost entirely ignorant of the metamorphoses of any Blattidæ, but it would be unwise to describe a new species based only on immature forms, and for the present they must remain without a name.

V. DESCRIPTION DE QUELQUES NOUVELLES CÉCIDOMYIES DES INDES.

Par l'Abbé J. J. KIEFFER, *Docteur phil. nat., professeur à Bitsch.*

La famille des Cécidomyies, si riche en espèces et si intéressante dans le genre de vie et les premiers états de ses représentants, commence aussi dans les Indes à attirer sur elle, l'attention des amis de la nature. Grâce au Rév. P. Auguste Haas, professeur de chimie à Trichinopoly, il m'a été possible d'observer et d'étudier les espèces suivantes [1]: *Clinodiplosis nodifex*, K., *C. artemisiarum*, K., *C. cellularis*, K., *Daphnephila haasi*, K., *D. glandifex*, K., *D. linderæ*, K., *Lasioptera longispatha*, K., *L. trilobata*, K., *Oligotrophus indianus*, K., *O. mangiferæ*, K., *O. quadrilobatus*, K., *O. tenuispatha*, K., *Peromyia bengalensis*, K., *Rhopalomyia haasi*, K., *Schizomia incerta*, K., et *S. indica*, K. Le zéle avec lequel le chef de l'Indian Museum, Monsieur N. Annandale, cultive l'Entomologie aux Indes, donne lieu d'espérer que dans un avenir peu éloigné, la connaissance des Cécidomyies aura fait de grands progrès dans ce pays. Nous donnons ici la description de deux nouvelles espèces.

Lestremia indica, sp. nov.

Jaune; thorax brunâtre, pleures plus claires; antennes et pattes brunâtres. Yeux glabres et confluents. Les quatre articles des palpes graduellement plus minces et plus longs, le quatrième presque deux fois aussi long que le troisième. Antennes de 2+9 articles ; les 9 articles du flagellum sessiles, de moitié plus longs que gros, sub-cylindriques, à peine amincis à leur extrémité, avec

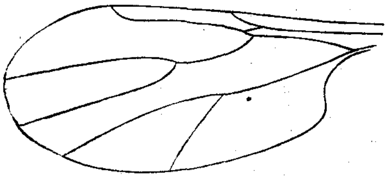

FIG. 1.—Aile.

1 "Etude sur de nouveaux Insectes et Phytoptides gallicoles du Bengale," *Ann. Soc. Scientif. Bruxelles*, 1905, vol. 29, p. 143—200, avec 1 planche et 15 fig. dans le texte ; "Description de Galles et d'Insectes gallicoles d'Asie," *Ibidem*, vol. 33.

un verticille de soies et sans autres appendices; article terminal plus de deux fois aussi long que gros, graduellement aminci à l'extrémité, sans prolongement. Ailes avec poils microscopiques qui leur donnent un aspect ponctué (fig. 1); partie distale de la 1 nervure de moitié plus longue que la transversale qui est très oblique; extrémité du cubitus située vis-à-vis de la base du 2^e tiers de la fourche de la 3^e nervure; tige de cette fourche égale à la moitié de la longueur de la fourche, un peu arquée, ayant son origine un peu avant l'extrémité de la transversale; les deux rameaux de la fourche, presque droits et subparallèles; 4^e nervure bifurquée avant la fourche de la 3^e, son rameau inférieur droit et très oblique. Métatarse antérieur aussi long que les trois articles suivants réunis; 5^e article trois fois aussi long que gros; pulvilles nuls; empodium plus court que les crochets tarsaux, ceux-ci ayant leur milieu élargi et dentelé. Dernier article des lamelles de l'oviducte deux fois aussi long que large. Taille ♀, 2 mm; Calcutta (N. Annandale).

Contarinia (*Stictodiplosis*) *pulcherrima*, sp. nov.

Imago.—D'un blanc sâle; antennes noires sauf les deux premiers articles; les quatre tarses antérieurs, l'extrémité des quatre fémurs antérieurs, les deux bouts des quatre tibias antérieurs et le métatarse postérieur noirs; le reste des pattes jaunes; larges bandes transversales sur l'abdomen, trois bandes longitudinales sur le mesonotum et taches sur les mésopleures et sur les métapleures brunes; pince du mâle brunâtre; dessus et dessous de l'abdomen et une tache latérale sur chaque segment avec de longs poils noirs; poils des pattes jaunes, ceux des taches noirs; occiput avec de longues soies arquées en avant; scutellum avec 12 soies fort longues; des soies semblables sur le bord postérieur des segments dorsaux de l'abdomen. Occiput avec un prolongement conique Palpes composés de 4 articles graduellement plus longs, le 4^e deux fois aussi long que le 3^e. Antennes de 2+12 articles; les deux premiers articles du flagellum soudés l'un à l'autre. Chez la femelle les articles du flagellum sont cylindriques, plus de deux fois aussi longs que gros, avec deux verticilles de soies et terminés par un col égal à la moitié de leur longueur, sauf le premier et le dernier; chez le premier, qui est cinq fois aussi long que gros, rétréci faiblement au milieu et parcouru transversalement par de fines lignes de poils, le col n'atteint que le cinquième de l'article; chez le dernier, le col est remplacé par un prolongement obtus qui est un peu plus long que gros. Chez le mâle, les articles du flagellum sont composés de deux nœuds, dont le basal est globuleux et le terminal est ellipsoïdal, sauf aux deux premiers articles qui ont les deux nœuds ellipsoïdaux; le rétrécissement qui sépare les deux nœuds est aussi long que le nœud supérieur, et un peu plus court que le col qui termine le nœud supérieur; chaque nœud porte un verticille de soies et un verticille de filets arqués, ce dernier à peine plus court que le premier et hyalin. Scutellum

avec 12 soies fort longues; des soies semblables sur le bord postérieur des segments abdominaux. Ailes jaunes, traversées par deux bandes transversales d'un noir bleuâtre; ces deux bandes

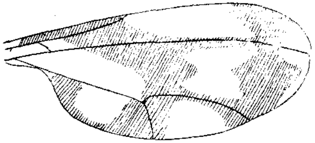

FIG. 2.—Aile.

sont reliées l'une à l'autre par deux traits dont le supérieur suit la 2[e] nervure, et l'inférieur suit le rameau supérieur de la troisième nervure; en outre, la première bande envoie un prolongement étroit le long du bord supérieur et du bord inférieur de l'aile jusque près de la base; les nervures sont jaunes ou noires, selon l'espace qu'elles parcourent; il en est de même des poils du bord costal. La nervure transversale est oblique et située au premier quart de la 1[e] nervure longitudinale; 2[e] nervure longitudinale droite aboutissant à l'extrémité alaire, le bord costal interrompu à cet endroit; rameau supérieur de la 3[e] nervure fortement arqué, l'inférieur presque perpendiculaire à la tige de la fourche. Aux pattes antérieures, le tibia est égal au 2[e] article tarsal, qui est aussi long que les trois articles suivants réunis; le 3[e] est d'un tiers plus long que le 4[e]; celui-ci quatre fois aussi long que gros, presque double du 5[e]; empodium aussi long que les crochets. Pince du mâle et oviducte de la femelle conformés comme d'ordinaire dans ce genre. Taille ♂ ♀, 2·8—3 mm.

Nymphe.—Armure frontale nulle. Soies cervicales très longues, plus longues que les stigmates thoraciques; ceux-ci bruns, arqués, à peine plus minces à l'extrémité qu'à la base, très longs, quatorze fois aussi longs que gros. Spinules dorsales jaunes, chaque série composée de 2 ou 3 rangées. Corps couvert de verrues petites, pointues, disposées en rangées, et groupées par deux.

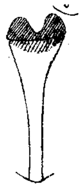

FIG. 3.—Spatule.

Larve.—Blanche ou vitelline, sans autre verrues que les spiniformes; papilles dorsales et latérales sans soie. Spatule jaune

(fig. 3), partie évasée divisée par une incision arquée, en deux lobes transversaux et obtus. Métamorphose en terre, en décembre ; éclosion quinze jours plus tard.

Oeuf blanc, trois fois aussi long que gros, muni d'un pédicule effilé et à peine plus court que l'œuf.

Galle.—Renflement des rameaux de *Symplocos theæformis*, L., ? plante nommée *Kharani* par les indigènes. Sous l'écorce se trouvent de nombreuses cellules situées sans ordre dans la couche ligneuse. Kurseong (R. P. Auguste Haas).

VI. DESCRIPTION OF NEW LAND AND MARINE SHELLS FROM CEYLON AND S. INDIA.

By H. B. PRESTON, *F.Z.S.*

Of the specimens described in the present paper, many were collected by the author in the years 1895—7 in the province of Uva, Central Ceylon, while others, including all the marine species, were obtained from the collection of the late Mr. Hugh Nevill, when that collection was dispersed at auction some few years ago in London.

1. *Euplecta foveolata*, sp. nov.

Shell broadly turbinate, sharply carinate, rimate, light yellowish brown, glossy, sculptured above with very indistinct spiral striæ and fine closely set arcuate riblets, base of shell polished, smooth, marked only with lines of growth; whorls 5½, rapidly increasing in size; sutures well-impressed; columella reflexed, thus partly concealing the narrow perforation; aperture obliquely sublunate; peristome thin.

Altitude ..	..	10·5 mm.
Diam., major ..	..	16 ,,
Aperture, alt. ..	..	6 ,,
,, diam.	..	7·25 ,,

Habitat—S. India.

A very graceful and beantiful species which, unlike most of the members of this group, shows no trace of granulation in the sculpture.

2. *Euplecta lankaensis*, sp. nov.

Shell thin, slightly polished, pale yellowish white, conoidal, slightly carinate; whorls 6½, very flat, sculptured with fine transverse lines of growth crossed by very indistinct spiral striæ, presenting a very fine decussate appearance; sutures not deeply impressed; base of shell somewhat convex; umbilicus very narrow and almost concealed by the reflexion of the columella; columella descending obliquely; peristome acute; aperture broadly lunate.

Altitude ..	..	7 mm.
Diam., major	..	8·25 ,,
Aperture, alt.	..	5·5 ,,

Habitat—Matale, Ceylon.

Allied to *Euplecta convexiuscula*, Pfr., but not marked with such coarse lines of growth ; the present species is also finely decussate and more strongly carinate; moreover, the spire is considerably higher and the whorls are much flatter.

3. *Euplecta neglecta*, sp. nov.

Shell conoidal, thin, pale brownish yellow ; whorls 6, sculptured with somewhat coarse, oblique, transverse striæ crossed by spiral striæ presenting in places a faintly decussate appearance, the last whorl acutely carinate at the periphery, the carina being of a paler colour than the rest of the shell ; sutures impressed ; base of shell very convex, smooth except for lines of growth ; umbilicus very narrow and partly covered by the reflexed columella ; columella descending vertically ; peristome acute ; aperture broadly lunate.

Altitude	.. ..	10 mm.
Diam., major	..	14·5 ,,
Aperture, alt.	..	5·5 ,,
,, diam.	..	6·5 ,,

Habitat—Uda Pussellawa, Ceylon.

The present species may be compared with *E. emilliana*, Pfr. ; it differs, however, from that species mainly in the following characters : its more conoidal shape and inflated base, its broader aperture and its much less markedly decussate sculpture.

It may be of interest to mention here that specimens of *Euplecta lævis*, Blanford,[1] occurred, though sparingly, with *E. neglecta*, and I take this opportunity of recording the fact, as in his description of *E. lævis* the late Dr. W. T. Blanford was unable to give an exact locality for his species.

4. *Microcystis edithæ*, sp. nov.

Shell depressedly turbinate, narrowly perforate, thin, semi-hyaline, polished, fulvous-brown ; whorls 4, minutely, spirally striate, the striæ being especially noticeable on the second whorl, the last two whorls marked with lines of growth ; base of shell sculptured with fine, wavy striæ presenting under the microscope an almost finely granular appearance ; sutures almost channelled ; columella reflexed over and partly concealing the umbilicus ; peristome acute ; aperture obliquely lunate.

Altitude	.. ..	1·25 mm.
Diam., major	..	2·5 ,,

Habitat—Uda Pussellawa, Ceylon.

A pretty little hyaline form whose nearest ally appears to be *M. thwaitesi*, Pfr. ; from this it is, however, easily distinguishable by its much smaller size and darker colour and by its having fewer whorls than that species.

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1 *Proc. Malac. Soc. London*, vol. iv, pp. 241—253.

5. *Microcystis thwaitesi*, Pfr., var. *depressa*, var. nov.

Much more depressed than the typical form, the spire being scarcely raised at all, in other respects it appears to be normal.

Habitat—Uda Pussellawa, Ceylon.

6. *Microcystis winifredæ*, sp. nov.

Shell depressed, narrowly perforate, thin, polished, shining, yellowish horn colour; whorls 3, sculptured throughout with very minute, spiral striæ; sutures impressed; umbilicus deep, very narrow, partly concealed by the reflexed columella; peristome simple; aperture broadly lunate.

Altitude ..	..	4·75 mm.
Diam., major ..	..	8·5 ,,
Aperture, alt.	..	4·25 ,,
,, diam.	..	3·5 ,,

Habitat—Uda Pussellawa, Ceylon.

7. *Thysanota elegans*, sp. nov.

Shell trochiform, rimate, vitreous, yellowish white; whorls 6, the first two rounded, spirally striate, the remainder sculptured with fine spiral lines crossed by coarser, transverse, arcuate striæ and bearing a strong, peripheral, hairy liration, the last whorl sharply carinate at the base; base of shell spirally striate only; sutures deeply impressed; umbilicus very narrow; peristome simple; aperture narrow, sublunate.

Altitude ..	..	1·75 mm.
Diam., major ..	..	1·5 ,,

Habitat—Uda Pussellawa, Ceylon.

Differing from *Thysanota hispida*, Sykes,[1] in its much smaller size and more graceful form; both the spiral and arcuate transverse striæ appear to be a character which are also absent in *T. hispida*.

8. *Glessula sinhila*, sp. nov.

Shell moderately thin, polished, dark yellowish horn colour, obtusely lanceolate; whorls 7½, marked with very faint lines of growth only; sutures impressed; columella descending in a very oblique curve; peristome simple, bent slightly inwards above; aperture inversely, elongately auriform.

Altitude ..	..	21·75 mm.
Diam., major	..	9 ,,
Aperture, alt.	..	7·75 ,,
,, *diam.*	..	4 ,,

Habitat—Ceylon.

1 *Proc. Malac. Soc. London*, vol. iii, p. 160.

Allied to *G. inornata*, Pfr., but easily distinguished from that species by its much more slender form.

9. *Mangilia (Daphnella) angusticincta*, sp. nov.

Shell fusiform, yellowish white, encircled by a suprasutural, thin, chocolate-coloured band which continues on the body-whorl below the periphery; whorls 6, strongly carinate above, sculptured with transverse costæ and fine spiral striæ, the last whorl bearing a somewhat coarse spiral liration towards the base; sutures scarcely impressed; peristome varicosely thickened; columella straight above, excavated below where it is stained reddish brown; aperture elongate.

Altitude	..	..	7·5 mm.
Diam., major		..	3 ,,
Aperture, alt.		..	2·5 ,,
,, diam.		..	·5 ,,

Habitat—Ceylon.

Allied to *D. bella*, Pease [1] (= *Mangilia interrupta*, Rve.), from which it differs in its narrower form, much more angled whorls and single narrow, deep, chocolate band; the costæ in the present species are also much stronger and the aperture is narrower; moreover, in *D. bella* the columella is not stained and is not so much excavated at the base as in *M. angusticincta*.

10—11. *Gorgina purpureo-cincta*, sp. nov.

Shell ovate, rather broad in proportion to its height, solid, coarsely tuberculate, the tubercles arranged in spiral rows, and sculptured throughout with spiral grooves and ridges, white, encircled with an infrasutural band of purplish brown, the last whorl painted with two other bands of the same colour between the rows of tubercles; whorls 5; sutures irregular, lightly impressed; peristome varicosely thickened, bearing five small denticles on the lower portion; columella almost straight and tinged with pale mauve, bearing three small denticles near its base, of which the middle one is the largest; canal very short; aperture ovate; interior of shell painted with two spiral bands of purplish brown, the intervening spaces being discoloured with a very pale shade of the same colour; operculum horny, with a central nucleus, purplish brown edged with a pale horn-coloured rim.

Altitude	..	..	8·5 mm.
Diam., major		..	5·25 ,,
Aperture, alt.		..	3 ,,
,, diam.		..	1 ,,

Habitat—Ceylon.

[1] *Proc. Zool. Soc. London*, 1860, p. 147.

12—13. *Nassa shawi*, sp. nov.

Shell solid, ovate, yellowish brown; spire acuminate; whorls 6½, rapidly increasing in size, sculptured with transverse costæ and somewhat coarse, wavy, spiral grooves which become obsolete at the periphery of the last whorl; sutures crenulate; columella finely denticulate at base, curved and extending upwards into a callus which reaches the lip above; peristome varicosely thickened behind, thin and serrated at the edge; denticulate just within the aperture; aperture sub-ovate; canal short.

Altitude ..	..	8 mm.
Diam., major	..	4·75 ,,
Aperture, alt.	..	2 ,,
,, diam.	..	1·25 ,,

Habitat—Ceylon.

14. *Pentadactylus ceylonicum*, sp. nov.

Shell fusiform, moderately solid, pale flesh colour; whorls 6½, sharply angled below the sutures, scabrous, sculptured with coarse transverse varices and reddish brown tuberculous ridges, the interstices occupied by spiral ridges of a finer character; sutures scarcely impressed, irregular; columella straight, bearing three very indistinct plaits towards the base and diffused into a callus which joins the lip above; outer lip serrated, bearing six plait-like denticles which run some little distance into the mouth of the shell; aperture ovate; canal rather broad, short, very slightly curved.

Altitude ..	..	19·75 mm.
Diam., major	..	10 ,,
Aperture, alt.	..	7 ,,
,, diam.	..	2·75 ,,

Habitat—Ceylon.

15. *Leptopoma taprobanensis*, sp. nov.

Shell pyramidal, white, painted with broad reddish brown flame markings; whorls 4½, convex, the apical whorls uniformly reddish brown, smooth, the remainder sculptured throughout with spiral liræ; sutures deeply impressed; base of shell convex; umbilicus moderately broad; peristome continuous, single, reflexed, white; aperture circular.

Altitude ..	..	6·5 mm.
Diam., major	..	6·25 ,,
Aperture, alt.	..	2·5 ,,
,, diam.	..	2·5 ,,

Habitat—Ceylon.

The spiral liræ of this species readily separate it from any other hitherto described form from Ceylon.

16. *Cyclophorus liratula*, sp. nov.

Shell subdiscoidal, moderately solid, covered with a brown periostracum; spire raised; whorls 3½, somewhat rapidly increasing in size, painted with broad, regular, brownish purple flame markings, rather coarsely, spirally lirate and very finely transversely striate; umbilicus wide and deep; peristome continuous, double; aperture nearly circular; interior of shell bearing a bluish white callus for a distance of about four millimetres from the aperture.

Altitude ..	..	6 mm.
Diam., major	..	11 ,,
Aperture, alt.	..	4 ,,
,, diam.	..	3·5 ,,

Habitat—Ceylon.

17—18. *Cyclophorus (Theobaldia) liliputiana*, sp. nov.

Shell small, suborbicular, depressed, white painted with a broad, reddish brown, subperipheral band, both above and below which occur zigzag flame markings of the same colour; whorls 4¼; spire scarcely raised; sutures deeply impressed; umbilicus wide and shallow; peristome white, continuous, double, slightly reflexed; aperture circular.

Altitude ..	..	4 mm.
Diam., major	..	10 ,,
,, minor	..	7·75 ,,
Aperture, alt.	..	3·25 ,,
,, diam.	..	3·25 ,,

Habitat—Ceylon.

Distinguished from any other Sinhalese member of the group by its extremely small size, vivid and well-marked painting and generally compact appearance.

19. *Cyathopoma ogdeniana*, sp. nov.

Shell turbinate, bearing traces of having been covered with a brown periostracum, sculptured above with distant transverse and spiral ridges, the former being absent on the base of the shell, in which region the latter are more numerous and less distant; whorls 4½, somewhat inflated; sutures deeply impressed; umbilicus wide and deep; peristome continuous, thickened, slightly reflexed and double throughout; aperture circular.

Altitude ..	..	2·5 mm.
Diam., major	..	2 ,,

Habitat—Uda Pussellawa, Ceylon.

In general outline and sculpture this species may be compared with *C. serendibense*, Preston [1]; the whorls of the present form are,

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[1] *Proc. Malac. Soc. London*, vol. v, pt. 5, 1903, p. 340.

however, more tumid, the umbilicus is wider and the peristome is throughout thickened, reflexed and double, which is not the case with *C. serendibense*.

I have much pleasure in associating with this species the name of my friend Mr. J. Armitage Ogden, of Kirklees Estate, Uda Pussellawa, on which estate it was collected.

20. *Cyathopoma perconoideum*, sp. nov.

Shell elongately conic, white, bearing traces of having been covered with a light yellowish brown periostracum; whorls 6, convex, sculptured with several spiral liræ; sutures impressed; umbilicus very narrow and partly concealed by the outward expansion of the peristome; peristome continuous, reflexed in the umbilical region and at the base, simple at all other points; aperture almost circular.

Altitude	..	..	2 mm.
Diam.	..	..	75 ,,

Habitat—Bandarawella, Province of Uva, Ceylon.

Allied to *Cyathopoma conoideum*, Sykes,[1] but more elongately conoid in form; the spiral liræ are also much more numerous than in that species. The umbilicus is narrower, being reduced in the present form to a mere chink; the aperture, moreover, is more nearly circular than in *C. conoideum*.

21. *Cyathopoma uvaense*, sp. nov.

Shell conoidal, greyish white, covered with a smooth chocolate-coloured periostracum, sculptured with fine spiral somewhat distant liræ; whorls 4½, shouldered above, moderately convex; sutures impressed; umbilicus wide and deep; peristome almost continuous, white, very slightly reflexed; aperture subcircular.

Altitude	..	..	3 mm.
Diam., major	..	..	3·5 ,,
Aperture, alt.	..	..	1 ,,
,, diam.		..	1 ,,

Habitat—Bandarawella, Province of Uva, Ceylon.

22. *Pecten helleri*, sp. nov.

Shell nearly equivalve, equilateral, subtrigonal very flat, creamy white, painted with broad, irregular, transverse, blood-red bands and ornamented on both valves with ten-grooved, rather broad and flattened, radiate ribs; the surface of both valves is also sculptured with closely set, fine, silky, concentric striæ; auriculæ nearly equal, radiately grooved, those of the left valve stained

1 *Proc. Malac. Soc. London*, vol. iii, p. 159.

with rusty red while those of the right valve are almost white; umboes small, acute.

Long.	..	..	20·25 mm.
Lat.	..	..	19·5 ,,

Habitat—Ceylon.

[N.B.—*The plate illustrating this paper will be issued later.*]

VII. DESCRIPTION OF TWO NEW SPECIES OF *CARANX* FROM THE BAY OF BENGAL.

By B. L. CHAUDHURI, *B.A.*, *B.Sc.* (Edin.), *Assistant Superintendent, Indian Museum.*

Caranx guptæ, sp. nov.

D. v/28-30. P. 24. V. 5. A. ii/17. Ll. 114 (keeled plates 33, spined 20).

Height of body 2, and length of head $4\frac{1}{4}$ in the total length. Eye large, its diameter being $2\frac{1}{2}$ in the length of head, with adipose lid all round, one diameter from end of snout and two apart.

Shape.—The anterior root of the soft dorsal is the highest point in the curved upper (dorsal) profile, the point being situated nearer to the posterior end. The posterior portion of the dorsal profile from this point is more curved than the anterior portion which is more sloping. In the lower (dorsal) profile the curvature from the posterior end suddenly stops at the anterior root of the

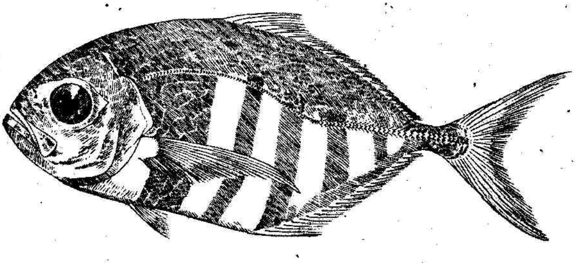

FIG. 1.—*Caranx guptæ*. sp. nov.

soft anal, from which point to a point directly below the lower jaw the profile is almost a straight line, which gives a characteristic shape to the species.

Mouth.—The cleft of the mouth is quite oblique, and is directed forward and upward. The lower jaw is longer than the upper.

Teeth.—Villiform and sharp in both jaws.

The pre-opercle is not serrated.

Fins.—The spinous portion of the dorsal fin is feeble and delicate, the anterior root of the soft anal is much behind the anterior root of the soft dorsal. There are two rudimentary detached anal

spines in front of the soft anal, which are concealed under a fold of skin. Pectorals long, slightly curved and tapering, contained $2\frac{3}{4}$ times in the total length. The ventrals are short and thick and arise vertically below the roots of the pectorals. The caudals are deeply forked.

Scales.—The scales are minute, the breast and head being perfectly naked.

Lateral line.—114 scales in all, of which the posterior 33 are covered with keeled plates; 20 of these keeled plates are armed with prominent spines. The lateral line runs straight forward from the root of the caudal fin until it passes all the keeled plates, when it curves forward, following almost accurately as a parallel curve of the anterior dorsal profile, ending in the upper corner of the operculum.

Colour.—Steel-grey with five broad vertical silvery bands which are more pronounced in the lower half. There is a small reddish area in the middle of the root of the caudal fin. The margins of the caudal and dorsal are tinged with black. There is a small horse-shoe-shaped mark in front of the snout coloured whitish grey on a black background.

Trawled by the "Golden Crown" off Elephant Point in July, 1908.

Length of two specimens.—16 cm.

Caranx auricoronæ, sp. nov.

D. vi/23. P. 22. V. 5. A. ii/21. C. 19. Ll. 80 (30 plates).

Height of body $1\frac{3}{4}$, and length of head $3\frac{1}{2}$ in the total length Diameter of eye $2\frac{3}{5}$ in the length of head, one diameter from end of snout and two apart.

Shape.—Highly compressed, both the dorsal and ventral profiles convex except in the anterior third of the ventral profile. No concavity in the anterior profile in front of the eye, but a small depression just anterior to the first dorsal.

Mouth.—Oblique, upper jaw not protrusible, lower jaw longer, slightly curved and not horizontal.

Teeth.—Villiform in both jaws.

Fins.—Spinous dorsal not rudimentary but well-developed, quite separated from second dorsal by a smooth open space; the spines of the first dorsal are joined together by thin white membrane. In the second dorsal a secondary sexual character is well-developed in the male but entirely wanting in the female. In the male specimen the 7th to 15th soft dorsal rays, inclusive, are prolonged to a considerable length in soft black filiform prolongations. Some of the rays anterior to these appear to have been damaged. These filiform appendages are wanting in the anal fin of the male fish and in both soft dorsal and anal fins of the female which was found to be full of matured ova. The ventral fin, which is a little longer than the head, is anterior to the origin of the pectorals, and

appears perpendicularly below the depression in front of the spinous dorsal. The ventral fin is comparatively large and fan-like, the rays being long enough to reach the anterior root of the anal fin. All the rays are joined together by parachute-like thin black membrane of considerable width. The ventral fin appears to cover completely a trenchant space with a groove which extends from the root of the ventral to the anterior root of the anal. Within this trenchant groove, at about its middle, the cloacal opening is situated, posterior to which are two rather long detached anal spines. The position and character of the parachute-like covering of the ventral fin suggests some accessory function subserving breeding or development. Pectoral nearly 1½ times as long as the head. No filiform prolongation of rays in the anal fin either in the male or female, but the anterior rays slightly longer than the more posterior ones. The caudal fin is deeply forked.

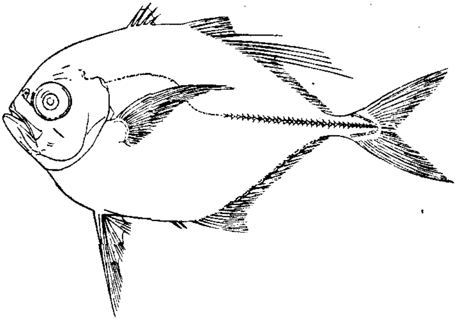

FIG. 2.—*Caranx auricoronæ*, sp. nov.

Colour.—Upper half steel-grey ; eyes, body of fins and lower posterior half golden, and lower anterior half silvery ; the edge of the caudal fin and soft dorsal black. The fold of thin membrane between the rays of the ventral fin quite black. There are, however, neither opercular spots nor any vertical bands or stripes of any kind in the adult.

Scales.—Present, small and deciduous, mostly in the caudal region.

Lateral line.—Covered with 30 plates which are not armed with spines nor keeled.

Two specimens, one male and one female with matured ova, caught by the steam trawler "Golden Crown" in the month of September, 1908, off the coast of Chittagong.

Length of specimens.—14 cm.

VIII. REMARKS ON SOME LITTLE KNOWN INDIAN OPHIDIA.

By F. WALL, *Major, I.M.S., C.M.Z.S.*

Through the courtesy of Dr. Annandale I have recently had access to the large collection of snakes in the Indian Museum, an examination of which has strengthened my convictions in many cases, and enables me to describe several new species and remark upon some rarities.

Tropidonotus xenura, Wall.

In the Bombay Natural History Society's Journal (vol. xvii, p. 616) I described and figured a new species under the above title, from a very sodden specimen submitted to me by the Bombay Society. The habitat of this was not known, and until recently it appeared to be unique.

In the Indian Museum I discovered, mixed up with several specimens of *Tropidonotus modestus*, Günther, four more examples of this species, all of which are from Cherrapunji, Khasi Hills, Assam. One of these is the No 4278 of Sclater's list.

All these specimens agree with the type except that the anal is divided in all. I think I was very probably in error in reporting this shield entire in the type, for I remember that in the sodden state of the specimen I found it difficult to decide the point to my satisfaction. In the type, again, the tail was extensively docked, but all the subcaudals present entire. In the four Indian Museum examples the subcaudals are also all entire. The ventrals and subcaudals are 161 + 107, 165 + ?, 158 + ?, 158 + 81. The tail is imperfect in two.

The divided state of the anal is remarkable. I cannot recall another snake with entire subcaudals and a divided anal.

The species bears a strong superficial resemblance to ***modestus***, but is very well differentiated and distinct. The differences are as follows: (1) in ***modestus*** the subcaudals are all divided; (2) in ***modestus*** there are two præoculars, in ***xenura*** only one; (3) in ***modestus*** there is one temporal, in ***xenura*** two; (4) in ***modestus*** keels are absent in the last two or three rows in midbody, in ***xenura*** all the rows are keeled.

Tropidonotus chrysargus, Schlegel.

Specimen No. 12680 in the Indian Museum from Tavoy, referred by Sclater to the Japanese species ***vibakari***, is an abnormal

specimen of this species. I have compared it carefully with other examples of *chrysargus*, and find it agrees perfectly in every way except as regards the temporals, which are single on both sides. The ventrals and subcaudals are 140 + 76. Anal divided.

Helicops schistosus, var *andersonii*, var. nov.

I have examined three specimens collected by Anderson in Yunnan which he, and subsequently Sclater, referred to *Helicops schistosus*.

In most respects extremely like *H. schistosus*, I cannot see how they can be considered as belonging to the typical form of this species in face of the fact that in all three the internasals are divided. A single internasal is stated to be one of the generic characters of *Helicops* to which all the eleven known species conform, and though I am very familiar with *schistosus* from Southern India, the United Provinces and Orissa, I have never met with one in which this shield was divided. The Yunnan form should, I think, rank as a variety of *H. schistosus*, under the title *andersonii*. I notice that, besides the condition of the internasals, all three specimens agree in having both the 1st and the 2nd supralabials touching the nasals, whereas in the typical *H. schistosus* the 1st only does so. The ventrals and subcaudals are 151 + 61 ?, 154 + 83, 143 + 79 ?. In two the tail is imperfect.

Dinodon septentrionalis, Günther.

Until recently the Indian Museum contained no specimen of this rare snake identified as such. I found, however, a very fine specimen in a bottle with specimens of *Bungarus bungaroides*. This is the No. 7741 of Sclater's list. Locality Darjiling. The scales are in 17 rows, vertebrals not enlarged; loreal present, pupil vertical, and ventrals and subcaudals 212 + 58 ? (tail imperfect). This specimen removes any doubt of the Eastern Himalayas as a habitat.[1] The type specimen collected by Jerdon was recorded dubiously from the Himalayas or Khasi Hills. Within our Indian dominions Boulenger has recorded a specimen from the Karen Hills (*Catalogue*, 1896, vol. iii, p. 619), and another from Mogok, Ruby Mines District, Burma (*Journ Bom. Nat. Hist. Soc.*, vol. xvi, p. 235). I have also had a very fine specimen from the Ruby Mines measuring 3 feet 4⅛ inches, ventrals 217, subcaudals 82, and another from Jeypore, Assam (♀), ventrals 214, subcaudals 81. The snake is remarkably like the many-banded krait *Bungarus multicinctus* in life or when recently preserved, the rich black on the dorsum crossed with milky-white bands giving it a strikingly handsome appearance.

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[1] I have recently had another specimen sent me from Phoobsering, below Darjiling (*circa* 5,000 feet).

Dryocalamus gracilis, Günther.

The specimen, No. 8690 from False Island, Arakan coast (?), referred by Sclater to *Hydrophobus davisoni* is, I think there can be no doubt, *Dryocalamus gracilis*. The scale rows are 15, the ventrals 236, subcaudals 85, anal divided. The loreal touches the eye and has a small præocular above. There are twenty-three whitish bands on the body, and fourteen on the tail. I think there is a good reason to doubt the locality for this specimen, as the snake is known otherwise only from Peninsular India. I have seen two specimens in life, both in Berhampore (Orissa). The ventrals and subcaudals were 243+79, and 235+87. In the former there were twenty-six bands on the body, and in the latter twenty-eight.

Ablabes gilgiticus, Annandale.

I have lately seen the type specimen of this species (described by Dr. Annandale, *J. A. S. Bengal*, 1905, p. 210) which proves to be *Trachischium fuscum* (Blyth). Dr. Annandale had already discovered the true identity of the specimen. The appearance of this species so far to the west of what had previously been known as its habitat is most interesting, and should serve to impress one with the limited knowledge we still possess of the snakes inhabiting the Himalayas although so many collectors have contributed to our knowledge of the fauna of that extensive Range. Previously the species had not been known to the west of Nepal.

Bungarus magnimaculatus, Wall and Evans.

In the *Journ. Bom. Nat. Hist. Soc.*, vol. xiii, p. 611, Captain (now Colonel) Evans and I made reference to a krait which we thought a species up to that time not described, but contented ourselves with making the type of a new variety of *B. cæruleus* under the title *magnimaculatus*. I have now seen five examples of this form, and have critically examined at the lowest computation over 200 specimens of *cæruleus*, and I am decidedly of opinion that *magnimaculatus* deserves recognition as a distinct species. Two of the five specimens I have examined are in the Indian Museum, and are the very ones remarked upon by Sclater (*J. A. S. Bengal*, lx, p. 245). As the form has never been properly described, I propose to do so now.

Description.—Rostral touches 6 shields, the rostro-nasal sutures are longer than the rostro-internasal. Internasals 2, the suture between the fellows about half that between the præfrontal fellows, half to three-fifths the internaso-præfrontal sutures. Præfrontals 2, the suture between them nearly twice the præfronto-frontal sutures; in contact with internasal, postnasal, præocular and supraocular. Frontal touches 6 shields, the fronto-parietal sutures longest. Supraoculars: length three-fourths to four-fifths frontal, breadth half or rather more than half frontal. Nasals touch the 1st and 2nd supralabials. Præocular 1. Post-

oculars 2. Temporal 1, touching the 5th and 6th supralabials. Supralabials 7, the 2nd much narrower than the 1st and 3rd, the 3rd and 4th touching the eye. Infralabials 4, the 4th largest, and in contact with two scales behind. Sublinguals 2 subequal pairs, the posterior touching the 4th only of the infralabial series. Costals two headslengths after head 15, midbody 15, two headslengths before vent 15; vertebrals as broad as long or broader in

Part of body of Bungarus magnimaculatus, ¾ size, showing two of the light bands.

midbody. Supracaudals in odd rows, the vertebrals enlarged. Ventrals 218 to 228. Anal entire. Subcaudals 43 to 48, all entire. Colour black with from eleven to fourteen light bands on the body and two to three on the tail. These light bands are formed of black and white streaks in the length of the snake, the vertebral white streak being specially broad. The intervening black does not extend to the belly, which is uniformly white. Some blackish mottling is present beneath the tail. A white præocular spot is more or less evident.

Habitat.—Known only from a very localised area in the Irrawaddy basin. Details of the specimens follow in tabular form.

Length.—The longest measurement is 4 feet. Nos. 4 and 5 are the specimens referred to by Sclater (*J. A. S. Bengal*, lx, p. 245).

No. of specimens.	Ventrals.	Subcaudals.	Light bands on body.	Light bands on tail.	Locality.	Remarks.
1	226	42[1] ?	14	2	Monywa	Types.
2	218	43	11	2	,,	
3	228	47	11	3	Meiktila	
4	225	48	11	3	,,	No. 13244, Indian Museum.
5	219	48	11	3	,,	No. 13245, ,, ,,

Bungarus walli, Wall.

In the *Journ. Bom. Nat. Hist. Soc.*, vol. xvii, p. 608, I described a new krait founded on a series of eight specimens

[1] Tail very slightly imperfect.

all from Fyzabad in the United Provinces. I have lately had opportunities of examining six more examples. In the museum of St. Joseph's College, Darjiling, I found two specimens labelled *cæruleus* which had formed part of the collection of the late Dr. Vincent Richards. Here I would recall the fact that this investigator succumbed to the wounds inflicted by a krait which may have been one of these specimens. This is by no means certain, as there are also in his original collection, now at St. Joseph's College, two specimens of *cæruleus*. The Principal of the College told me that his death is attributed to one of these snakes, but could not be sure which, and I can get no further information of the fatality. One of the *walli* could not, I think, have inflicted the injury, as its mouth is full, with the caudal extremities of two slow-worms (?) (*O. gracilis* ?) protruding.

Unless the coloration of one of these specimens is due to the quality of the preservative, it must be considered a melano, as the under parts and the upper lip are black. The usual beaded, white, equidistant dorsal arches are, however, quite distinct. The localities of these two specimens are not recorded, but it is probable they were obtained from Bengal. The other four specimens alluded to are in the Indian Museum. Three of these are old, and were referred to *cæruleus*. The last is the large specimen referred to by Dr. Annandale as *sindanus* (*J. A. S. Bengal*, 1905, p. 213). I give the details of these specimens in tabular form :—

No. of specimens.	Scales two heads-lengths behind head.	Scales midbody.	Scales two heads-lengths before anus.	Ventrals.	Subcaudals.	Locality.	Remarks.
1	19	19	17	203	54	?	St. Joseph's College.
2	17	17	17	192	48	?	,, ,, ,,
3	19	17	17	199	54	Purneah	No. 13760, Ind. Museum.
4	19	19	17	197	52	,,	No. 13762, ,,
5	19	17	17	202	55	,,	No. 13764, ,,
6	19	19	17	200	51	Midnapore	No. 15299, ,,

The largest measurement now recorded is that of the Midnapore example (5 feet 4½ inches).

Amblycephalus modestus, Theobald.

I have examined the type and only known specimen of this snake, which has only been imperfectly described, and propose to give a full description here.

Description.—Rostral in contact with 6 shields, the anterior nasal sutures greater than the internasals. Internasals: suture between the fellows two-thirds that between the præfrontal fellows, one-third the internaso-præfrontal sutures. Præfrontals:

suture between the fellows two-thirds the præfronto-frontal sutures, in contact with internasal, loreal, præocular, eye and supraocular. Frontal in contact with 6 shields, the supraocular sutures are smallest, about two-thirds the parietals, and three-fifths the præfrontals. Supraoculars half as long as and one-third as broad as the frontal. Nasals touch the 1st and 2nd supralabials, undivided. Loreal in contact with the internasals. Præoculars 2, small. Postoculars 2 on the right side, 1 on the left entirely cutting off the labials from the eye. Temporals: a single anterior shield which, however, especially on the right side, appears to be a confluence of 2—an upper and a lower. Supralabials 7, the seventh longest, none touching the eye. Sublinguals: three large pairs of broad shields with no mental groove between, followed by a very large first ventral. Costals two headslengths after head 15, midbody 15, two headslengths before vent 15. Vertebrals not enlarged. Ventrals 156. Anal entire. Subcaudals 37, divided. Body compressed. Eye large, pupil vertical. Colour uniform dark olive-black.

I can see no difference in the lepidosis between this and *macularius* except in the temporal, which is possibly aberrant The 2nd and 3rd supralabials touch the loreal (instead of the 2nd only), but the same anomaly is seen in specimen No. 8026 in the Indian Museum from Martaban, which is one of the types of *macularius*. The only real difference appears to me to be in the colours, but the specimen may be a melanotic form of *macularius*.

Here I may say that I count the ventrals and subcaudals of the three type specimens of *macularius* 169+40, 168+48, and 170+51.

IX. REMARKS ON SOME FORMS OF *DIPSADOMORPHUS*.

By F. WALL, *Major, I.M.S., C.M.Z.S.*

Many of the forms now recognised as species in the genus *Dipsadomorphus* exhibit extremely close affinities. A close study of the head shields of many of the species (I have examined no less than thirteen of the twenty-three known) shows a number and disposition so similar, that, with the single exception of the rostral shield in some few species, I can find no means of differentiating between them. The only points made special use of by Mr. Boulenger, *viz.*, the height of the præocular and the size of the posterior sublinguals, with the separation of the fellows of this pair, I find too inconstant to place any reliance upon.

The close similarity of these shields in the different species probably accounts for the frequent confusion among them by various observers. Thus *trigonata* has been mistaken for *gokool* by Ferguson (*Reptil. Fauna Ceylon*, 1877, p. 21), Phipson (*Journ. Bom. Nat. Hist. Soc.*, vol. ii, p. 247) and Traill (*Journ. Bom. Nat. Hist. Soc.*, vol. ix, p. 499). *Gokool* was considered the young of *cynodon* by Cantor (*Cat. Mal. Rept.*, 1847, p. 77).

The *multifasciata* of Günther was confused for a long time with *ceylonensis*. Stoliczka (*Journ. Asiat. Soc. Bengal*, vol. xxxix, p. 199) could not see the justification for considering it a species apart, though Blyth and most herpetologists since his time wholly support Günther's views. Boulenger (*Faun. Brit. Ind.*, Rept. and Batrach., 1890, p. 359) did not separate it from *ceylonensis*, though later (*Cat.*, iii, 1896, p. 69) he too has accepted Günther's opinion.

I have for a long time thought that the species *ceylonensis* and *hexagonotus*, as regarded by Mr. Boulenger in his *Catalogue* (1896), comprise more than one form fit to rank as a species, and I have been accumulating observations for some years which now enable me to speak with conviction.

The separation of the species in this genus is mainly, if not wholly, dependent upon the difference in the number of the scale rows, the degree of enlargement of the vertebrals, and the differences in the ranges of the ventrals and subcaudals. I think more use may be derived from the scale rows by counting them in two situations instead of in midbody alone. I find that at a point two heads-lengths before the anus the rows are fewer than in midbody, and at least in one instance the counts are useful, for in the two species *trigonata* and *gokool*, which are extremely alike, the rows come to 15 in the former and only to 17 in the latter.

Dipsadomorphus ceylonensis.

I have arranged all the specimens identified as *ceylonensis* of which I have any knowledge in tabular form. The British Museum examples and the four I quote from Dr. Willey (*ex epistola*) I have not examined.

(1) *D. ceylonensis*, Günther.

Characterised by scales in 19 rows, ventrals 214 to 235, subcaudals 98 to 109. Habitat—Ceylon and Western Hills of Peninsular India.

No. of specimens.	Scales in midbody.	Ventrals.	Subcaudals.	Habitat.	Authority.
1	19	229	105	Mysore ..	Indian Museum.
2	19	227	109	Madras Presdy.	,,
3	19	223	106	,, ..	,,
4	19	219	100 ?	Anamallay ..	,,
5	19	227	..	,, ..	,,
6	19	234	105	,, ..	British Museum.
7	19	229	100	Nilgiris ..	,,
8	19	214	98	Malabar ..	,,
9	19	235	111	Matheran ..	,,
10	19	235	107	Ceylon ..	,,
11	19	229	..	,, ..	,,
12	19	231	..	,, ..	,,
13	19	232	104	,, ..	,,
14	19	219	101	,, ..	,,
15	19	222	99	,, ..	,,
16	19	226	103	,, ..	,,
17	19	220	101	,, ..	,,
18	19	234	110	,, ..	Dr. Willey (*ex epistola*).
19	19	234	106 ?	,, ..	,,
20	19	233	107	,, ..	,,
21	19	224	103	,, ..	,,

(2) *D. beddomei*, sp. nov.

Characterised by 19 scale rows, ventrals 248 to 266, subcaudals 113 to 127. Habitat—Ceylon and Western Ghats.

No. of specimens.	Scale rows in midbody.	Ventrals.	Subcaudals.	Habitat.	Authority.
1	19	257	126	Ceylon ..	British Museum.
2	19	262	125	,, ..	,,
3	19	253	113	,, ..	,,
4	19	266	120	,, ..	,,
5	19	253	122	,, ..	,,
6	19	263	127	Kandy ..	F. Wall.
7	19	248	117	Matheran ..	British Museum.

(3) *D. nuchalis*, Beddome.

Characterised by 21 scale rows (rarely 23), ventrals 234 to 251, subcaudals 90 to 108. Habitat—Hills of Western Peninsular India and Nepal.

No. of specimens.	Scale rows in mid-body.	Ventrals.	Subcaudals.	Habitat.	Authority.
1	21	235	101	Chitlong, Nepal	Indian Museum.
2	21	234?	104	,, ..	,,
3	21	246	100 ?	Travancore ..	,,
4	21	251	106	,, ..	,,
5	21	242	102	,, ..	,,
6	21	246	107	,, ..	,,
7	23	238	103	,, ..	,,
8	23	241	106	,, ..	,,
9	21	249	108	,, ..	,,
10	21	242	107	,, ..	,,
11	21	248	90	Wynaad ..	British Museum.
12	21	242	100	W. India ..	,,
13	21	243	104	,, ..	,,
14	21	234	94	,, ..	,,
15	21	234	102	,, ..	,,
16	21	249	101	,, ..	,,

(4) *D. andamanensis*, sp. nov.

Characterised by 21 scale rows, ventrals 259 to 267, subcaudals 118 to 133. Habitat—Andamans.

No. of specimens.	Scales in midbody.	Ventrals.	Subcaudals.	Habitat.	Authority.
1	21	267	121	Andamans	No. 7928, Indian Museum.
2	21	266	118	,,	No. 7929, Indian Museum.
3	21	265	122	,,	No. 7930, Indian Museum.
4	21	264	133	,,	No. 8641, Indian Museum.
5	21	259	121	,,	No. 15189, Indian Museum.
6	21	264 ?	130	,,	No. 15192, Indian Museum.

From the above tabulated specimens it appears to me that under the title *ceylonensis* at least four distinct forms have been confused, all of which I consider should rank as species rather than varieties of a single species. For the first of these I would reserve the title *ceylonensis*, for Günther's type specimen with scales 19, ventrals 220, subcaudals 108, habitat Ceylon, clearly is one of this form.

For the second *beddomei* seems to me appropriate, since most of the known specimens are of Colonel Beddome's collecting.

For the third Beddome's name *nuchalis* should be retained.

For the fourth I propose *andamanensis* since all the six known specimens come from this insular group.

The last-named form, *andamanensis*, has perplexed more than one authority. Stoliczka (*J. A. S. Bengal*, xxxix, p. 198) referred to four specimens in the Indian Museum from the Andamans which he identified as *hexagonotus* (Blyth). These are the first four specimens in the table above and the identical ones referred later by Sclater to *fusca*.[1] I have examined these, and two others in the Indian Museum acquired since from Mr. C. G. Rogers from the Andamans. The last two were sent by Dr. Annandale to the British Museum, where they were pronounced by Mr. Boulenger to be *ceylonensis*. These I examined two years ago on their return from London, and disagreed with Mr. Boulenger's opinion. I have recently re-examined them beside the other four specimens, with which they completely agree. The recognition of this form as a distinct species removes the Andamans from the sphere of distribution of *ceylonensis* (Annandale, *J. A. S. Bengal*, 1905, p. 176).

All of these forms seem to me to agree in the lepidosis of the head, and have the vertebral row of scales about as broad as long at midbody. They are all coloured much alike, and seem to attain a similar growth.

Dipsadomorphus hexagonotus, Stoliczka (*non* Blyth).

I have examined the type specimen of Blyth's *hexagonotus* (*Journ. Asiat. Soc. Bengal*, vol. xxiv, p. 360). This is No. 8048 of Sclater's list from Cherrapunji, Khasi Hills, Assam, referred by him to *fusca* (an Australian species !). The scales are in twenty-one rows, the ventrals 247, and the subcaudals 134 (not 126 as given by Blyth [2]). It is now uniform brown in colour. I think there can be no doubt that this is a young *cyaneus* (Dum. & Bibron). The young of this species are known to be brown in colour (Boulenger, *Catalogue*, vol. iii, 1896, p. 72). Further, Blyth says of this specimen that the head is green, and remarks that it probably grows to a large size and may become wholly green.

The next authority to refer to *hexagonotus* was Stoliczka (*Journ. Asiat. Soc. Bengal*, vol. xxxix, p. 198) who refers to five specimens from the Andamans. Four of these I have already alluded to under *ceylonensis* and shown to constitute a definite

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[1] The fifth specimen referred by Sclater to *fusca* is in my opinion a young *cyaneus* : see further remarks on *hexagonotus* which follow.

[2] I frequently find that my counts of the ventrals and subcaudals, especially the latter, do not agree with that of other authors, and I often wonder whether they made use of a lens at this time, and if so, whether the lens permitted freedom of both hands. The subcaudals especially are very hard to count in small snakes. I invariably use a watchmaker's lens, and begin counting from the tail-tip. In this way the smallest shields are counted when the eye is fresh to the work, and as it grows tired with the strain, the larger shields come into view. I also pass the fingers of one hand along the shields as I count them, thus assisting the eye and relieving strain.

species, *andamanensis*. The fifth with the scale rows 19 is described too imperfectly to recognise with certainty, but appears to me probably the same form found in Burma in which the scale rows are 19. If my surmise is correct, this specimen, which appears to have been lost, is the true type specimen of *hexagonotus*, and Stoliczka's name should replace Blyth's as the godfather of the species, *hexagonotus* having precedence over Theobald's *ochracea*.

Under the title *hexagonotus* Mr. Boulenger appears to me to include two forms which I consider deserve specific recognition. I have records of fourteen specimens of a form from Burma which agree in having 19 scale rows, the ventrals ranging between 221 and 245, and the subcaudals 89 to 107. Five of these are in the British Museum, the rest are of my own collecting. Two other specimens in the British Museum from Burma collected by Beddome do not conform to this type, but to that known from the Himalayas. In recent papers to the Bombay Natural History Society I have shown that many of Beddome's records of habitat are open to question, but even supposing that these two specimens have been correctly labelled, they do not vitiate the inferences to be drawn from the series under discussion, as they may have come from hills in the west or north of Burma, the fauna of which closely agrees with that of the Eastern Himalayas. I am of opinion that the form represented by these fourteen specimens all from Burma is a distinct species for which the name *hexagonotus* should be retained, as it appears probable that the type specimen is that already referred to from the Andamans by Stoliczka with the scales in 19 rows.

In addition to these I have examined no less than thirty-nine specimens of a form which inhabits the neighbourhood of Darjiling, and which is characterised by having 21 scale rows, ventrals ranging from 218 to 252, and subcaudals from 100 to 119. There are three more examples in the British Museum from the same locality which completely agree. Two others in the same Institution from Burma (?) (the query is mine) also agree. This form appears to me a distinct species for which I propose the name *stoliczkæ*, the first references to it having been made by Stoliczka

X. A PELAGIC SEA-ANEMONE WITHOUT TENTACLES.

By N. ANNANDALE, *D.Sc., Superintendent, Indian Museum.*

During a visit to Puri, on the Orissa coast of the Bay of Bengal, my assistant brought me (on February 1st, 1909) a number of small, more or less globular bodies which he had found on the beach at the edge of the waves. A careful search revealed many more. On examination these bodies proved to be Actiniaria in a state of contraction. On being placed in clean sea-water they immediately changed their shape, becoming narrowly conical instead of globular; but no tentacles appeared. The oral extremity became nearly flat, the peristome being distinguished from the column by its greater translucency as well as its position. The mouth was conspicuous, forming a relatively long, narrow slit expanded at one end. The whole animal had a milky appearance, which concealed its internal organs; the exterior had a pale vinous colour, which deepened into brown at the aboral pole. A circular pore was easily seen at this pole.

As these Actinians evidently represent a form very different from any previously described, I propose to call them *Anactinia pelagica*, gen. et sp. nov., in allusion to their lack of tentacles and their pelagic habit. Although none of my specimens have gonads in a recognizable condition, I do not think that they represent a larval stage, for on the one hand the large number of mesenteries they possess, and on the other the fact that many Actinians only exhibit sexual activity at certain times of year, is evidence to the contrary. Several forms have, however, been described by van Beneden as larvæ which possess a considerable number of mesenteries. The following description is based on the dissection and sectioning of a number of specimens as well as on the superficial examination of living and preserved material.

STRUCTURE.

Column.—The column may be any shape between globular and conical, the aboral end being pointed in the latter case and the peristome nearly flat. These differences in form are due solely to the state of contraction or expansion of the muscles. My largest specimens measured, when fully expanded, about 12 mm. in length and 4 mm. in transverse diameter across the peristome, which met the walls of the column practically at a right angle. In such specimens the aboral extremity measured only 1 mm. in diameter, the

basal pore, which was circular, measuring about 0·75 mm. The external surface was smooth on the upper half of the column, longitudinally plicated to a slight extent on the basal half. Most or all of the mesenterial spaces appeared on the external surface as slightly elevated ridges separated from one another by narrow grooves, which represented the mesenteries. There were no apertures of any kind on the sides of the upper parts of the column; but near the base I have been able to detect a number of minutely microscopic circular pores. These have no swollen lips and do not appear to function as cinclides. The external cilia are short and feeble. There is no protective sheath, and the secretion of the ectodermal gland-cells is by no means profuse.

Peristome.—The most remarkable feature of the peristome is the almost entire absence of tentacles. An examination of living material failed to reveal any trace of these organs; but in specimens preserved in spirit they can be seen to exist as minute rudiments, which to the naked eye or under a hand lens appear as a single circle of white dots, one at the upper extremity of each mesenterial space, that is to say, 24 or 26 in all. These dots are situated round the periphery of the peristome. They are imperforate and so minute that it is barely possible to see them in profile with the aid of the most powerful hand lens. They are only visible owing to their greater opacity, which is due to the fact that each represents a reduplication of the body-wall, or rather a microscopic hollow outgrowth. Their structure appears to be in no way differentiated from that of the surrounding parts.

The peristome itself is nearly flat in fully expanded specimens, but when the muscles of the column are contracted it is usually concave; sometimes, owing to a partial evagination of the stomodæum, it becomes highly convex or even conical.

The lips of the mouth are by no means tumid and do not appear to be capable of very close juxtaposition. The upper extremity of the ciliated groove of the stomodæum is represented at one end by an expansion, which in some cases is nearly circular. The mouth occupies the greater part of the diameter of the peristome in one direction and is rather narrow in the other; its two ends are about equidistant from the edge of the peristome.

Body-wall.—In a transverse section through the body-wall the ectoderm is seen to consist of the elements commonly found in the ectoderm of the Actiniaria. The epithelial cells bear very short cilia. Gland-cells are, as usual, of two kinds, one more elongated than the other; but both are somewhat scarce. Sense-cells, each bearing a rather stout style, are numerous. Nematocysts are extremely abundant all over the surface of the column. They vary greatly in size but are fairly constant in shape and proportions. All are rounded at either end somewhat abruptly and most are curved; the length is about $\frac{1}{8}$ the breadth, and varies from 0·0162 mm. to 0·042 mm.

Immediately inside the ectoderm there is a ring of clear mesoglœa, in which minute star-shaped cells and extremely slender

transverse nerve-fibres can be detected with some difficulty. This is clearly the so-called nervous layer.

Inside the nervous layer is a considerably broader one, which also consists fundamentally of mesoglœa but is noteworthy for the fact that it contains numerous bundles of longitudinal muscle-fibres, which in cross-section appear as slightly oblique transverse bars or narrowly oval masses. Often they are arranged in such a way that two succeeding bars form an angle with one another. At the inner end of these longitudinal muscles is a narrow but very distinct ring of circular muscle-fibres. An examination of the body-wall from the inner surface shows that these circular muscle-fibres form a series of parallel rings extending from the upper end to the base of the column, at the two ends of which they are rather stouter than they are in the middle. There is not, however, a regular sphincter at either end.

The endoderm of the body-wall consists of rather long, highly vacuolated cells. The cilia with which they are provided are barely visible in my sections. At the base of many of these cells peculiar sausage-shaped bodies are present, each containing two or more round structures which take up eosin very strongly. Probably these bodies are micro-organisms of some kind.

In a transverse section of the body-wall, opposite the middle of the stomodæum of a fully expanded specimen, the ectoderm is the broadest of the apparent layers, occupying more than a third of the total thickness (*i.e.*, about 0·4 mm. out of a total of 1·06 mm.). The whole of the mesoglœa is considerably narrower, occupying about 0·3 mm.; of this one-third is occupied by the nervous layer and two-thirds by the muscular layer. The endoderm is rather thicker than the mesoglœa at some points, thinner at others.

Stomodæum.—The stomodæum extends in fully expanded specimens about a third of the way to the base of the column. It is much compressed but relatively broad, its two ends being nearly equidistant from the body-wall. A ciliated groove is present at one end only; in the middle part of the stomodæum it is of considerable size as compared with the remainder of the internal periphery. Its cilia are long and stout compared with those of the ectoderm on the external surface of the column. The musculature of the stomodæum resembles that of the body-wall in arrangement, but the longitudinal muscles are not so well developed and the circular muscle is very feeble.

Mesenterics.—In the smaller specimens I have examined there are 24 mesenteries, in the larger specimens 26. The mesenteries are not arranged in pairs, and have no muscle-banners (retractor muscles); all are entire. In transverse section each is seen to be considerably swollen in the middle and narrow at either end, *i.e.*, at the inner end, which is joined to the mesentery, and at the outer end, which is joined to the body-wall.

A band of mesoglœa makes its way into each mesentery from either end, appearing in transverse section as a slender filament; at its outer extremity each band of mesoglœa supports a few

transverse muscle-fibres. I have not been able to detect longitudinal muscles in the mesenteries at any point. The swollen appearance of the central part is due solely to enlargement and vacuolation of the endoderm cells which form the bulk of the mesentery. These cells have very minute nuclei, which are situated at their free edge.

The outlines of the mesenteries in transverse section are important in relation to the position of the mesenterial mesoglœa. In few mesenteries does this occupy the middle line exactly, but in nearly all cases it is slightly nearer one surface than the other (plate ix, figs. 5, 6). Moreover, the surface from which it is most remote can in most cases be seen to be more broadly convex than that to which it is nearest. All the mesenteries, therefore, may be said to point in one direction. This direction is that most remote from the apex of the ciliated groove.

The mesenteries decrease in transverse length at either end of the stomodæum, those at the apex of the ciliated groove being not quite so short as those opposite them.

The mesenterial filaments are less strongly contorted than is the case in many Actinians. On some mesenteries they run almost straight from the lower end of the stomodæum to the base of the mesentery, while in others they are contorted only in the middle part of their length. The longitudinal groove running down the upper part of each filament is deep, and the corresponding ridge on the middle part high; otherwise the minute structure of the filament offers no particular feature of interest.

Some of the mesenterial filaments are continued at the lower extremity of the mesentery so as to form acontia, which can be thrust out of the basal pore or even of the mouth; but the acontia are much shorter than is usually the case in the Sagartiidæ, and, moreover, do not seem to be particularly well supplied with nematocysts, although those structures occur in them in considerable numbers. So far as I can find, neither the number of the acontia nor the exact mesentery to which each is attached is in any way a constant character. There are no acontia-like filaments on the upper part of the mesenteries.

There are no mesenterial foramina.

Gonads[1] are absent from all the specimens I have examined, but, as I have already pointed out, this may be due to the fact that my specimens were not collected during the breeding season.

BIOLOGY

Anactinia does not appear to have any means of independent progression, and my specimens exhibited no movements except

[1] In a specimen taken by Dr. J. Travis Jenkins on the surface of the sea about 10 miles off the Orissa coast on February 20th, 1909, immature testes are present. They occur on some of the mesenteries, not on all; there appears to be a tendency for fertile and infertile mesenteries to alternate, but this rule is not without exceptions.—*March 3rd*, 1909.

those implied in their change of shape. They were, however, practically of the same specific gravity as that of sea-water on the surface of the Bay of Bengal. There can be little doubt that they had been carried by the currents and the winds, so far as the latter affected the water on the surface. The individuals cast up on the beach at Puri had evidently been driven through the surf-line, probably by a stiff breeze acting on the surface of the water. It is noteworthy that though they were numerous on February 1st, not a single specimen was found on January 29th, 30th, 31st, or on February 2nd.

It is well known that surface animals without independent means of progression often occur in vast shoals of the same species This fact was well illustrated at Puri on the occasion on which *Anactinia* was found. On January 29th and 30th large numbers of a species of *Porpita* were washed ashore. Among them were a few specimens of a species of *Velella*. On January 31st, however, the relative proportions of the two genera were reversed, *Velella* becoming abundant and *Porpita* scarce. On February 1st both were scarce, but *Anactinia* was abundant, while on February 2nd, after a sharp shower of rain during the night, very few surface organisms of any kind were found on the beach.

I can find no trace of food in any of the specimens of *Anactinia* I have dissected.

SYSTEMATIC POSITION.

The arrangement of the mesenteries, the position of the longitudinal muscles of the column and the presence of a single ciliated groove running down the stomodæum are all facts which link *Anactinia* with *Cerianthus*, and there can be no doubt that it should be placed in the same order as that aberrant form. The absence of tentacles, however, as well as other less important differences, point to a very distinct separation between the two genera. *Anactinia* in all probability is a member of the order Cerianthidea which has become modified in accordance with a pelagic life.

It is worthy of remark in this connection that the larvæ of *Cerianthus* are pelagic in habit but settle down at the bottom before they have developed many tentacles. The young of Actiniaria, however, as also those of some other Cœlenterates, appear to provide for their own distribution mainly in two different ways. Those of *Sagartia troglodytes*, *Actinia mesembryanthemum* and some other common viviparous species, for example, retract the tentacles with which they are provided at birth, close their mouths and, being of almost the same specific gravity as the water in which they live and not having any projecting structures on their surface, are rolled over and over by the slightest movement in the water and are so carried for considerable distances. The young of *Metridium schillerianum*, of *Cerianthus* and of some species of *Hydra*, on the other hand, expand their tentacles to the utmost (so as to cover as large a superficial area as possible) and float on

or near the surface, that is to say in a position in which external agencies act most readily on the water and therefore on the organisms which it contains. *Anactinia* appears to have adopted the former means of progression and to have become modified accordingly, probably in the course of evolution from a Cerianthid ancestor.

As regards described forms to which *Anactinia* may be allied, it bears a somewhat close external resemblance to the minute larva described by van Beneden (*Les Anthozaires de la "Plankton-Expedition,"* p. 107, pl. ix, 1898) as *Apiactis denticulata*, but, apart from other differences, exhibits no trace of the thickening of the mesoglœa characteristic of that form. Possibly it is related to the same author's *Ovactis* (*op. cit.*, p. 56), but there are several important features wherein it differs from that genus. Both these forms are regarded by van Beneden as larval.

Considering the doubt which exists as to the maturity of my specimens and the resemblance they bear to some of van Beneden's genera, I think it best not to define the form they represent as the type of a new family, but the genus and species may be described as follows :—

Genus ANACTINIA, nov.

Pelagic Cerianthidea without tentacles or a protective sheath. The musculature of the column as in the Cerianthidæ. Mesenteries twenty-four or more ; the membranous part of each mesentery strongly developed and forming in cross-section a protrusion directed away from the ciliated groove. Acontia but no (?) cinclides present. Column conical when fully expanded, the aboral pole being pointed. The external surface smooth, feebly ciliated. Ectoderm richly armed with large nematocysts at every point. The ciliated groove of great extent relative to the stomodæum. The mesenteries at both ends of the stomodæum very short. No foramina in the mesenteries.

Anactinia pelagica, sp. nov.

Peristome at right angles to the column when fully expanded. Mouth slit-shaped, with the ciliated groove always more or less patent at one end. A microscopic, imperforate tubercle (representing a tentacle) on the external surface above the upper end of each mesenterial interval. Mesenteries 24 or 26. External surface minutely plicated longitudinally at the aboral end. Colour pale, with a slight vinous tint, which deepens to light brown at the aboral pole ; the external tissues somewhat feebly translucent, having a milky appearance in life. The basal pore relatively large, not provided with a sphincter.

EXPLANATION OF PLATE IX.

FIG. 1.—*Anactinia pelagica* in a fully expanded condition viewed from the side, × 5.

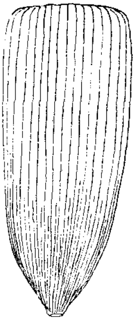
,, 2.—A slightly oblique lateral view of an individual partially contracted, × 8.

,, 3.—The peristome of the same specimen viewed from above, × 8.

,, 4.—Transverse section through the column on a level with the middle of the stomodæum, × 8: *c.* = ciliated groove.

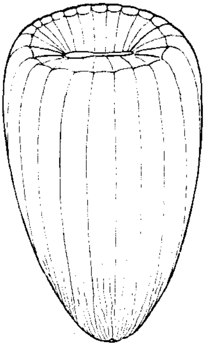
,, 5.—A portion of the same, × 16.

,, 6.—Transverse section through the body-wall in the same region, highly magnified: *ect.* = ectoderm; *n.l.* = nervous layer; *l.m.* = longitudinal muscles; *c.m.* = circular muscles; *en.* = endoderm.



×5.

Fig. 1



×8.

Fig. 2.

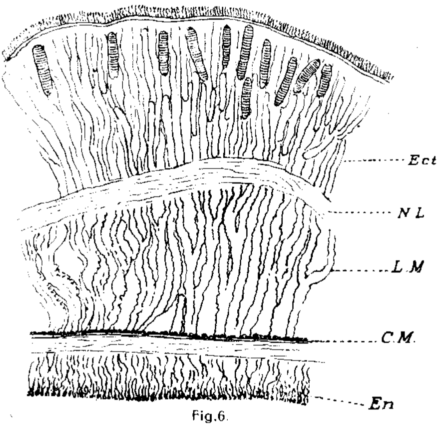
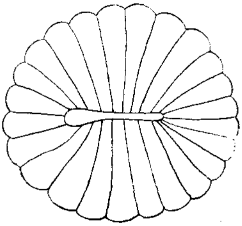
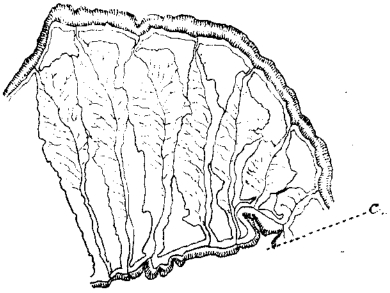


Fig.6.



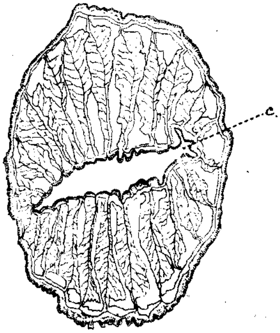
×8.

Fig. 3.



×16.

Fig. 5.



×8.

Fig.4 .

ANACTINIA PELAGICA, gen. et sp. nov.

XI. RHYNCHOTA MALAYANA.

PART II.

By W. L. DISTANT.

The present contribution again largely refers to the Rhynchota of Borneo. The collections made by Wallace in his memorable Malayan expedition contained much Bornean homopterous material which was worked out by Walker, but this was evidently only a sample of the rich Rhynchotal fauna of that island. The Homoptera of the Dutch islands are still practically unknown. Bierman commenced the study of the Javan insects and might have adequately undertaken those of Celebes, but we have, unfortunately, to deplore his early decease. The Malay Peninsula is still somewhat unworked ground as regards the Homoptera. Annandale and Robinson have lifted the veil from the Siamese Malay States, but we cannot expect the same enthusiasm to be displayed by residents in the collection of Rhynchota as I still gratefully remember was the case with butterflies when I prepared my "Rhopalocera Malayana." As regards the Philippines, of course, Stål's "Hemiptera insularum Philippinarum", is an object-lesson to other workers.

Sub-order HETEROPTERA.

Fam. PENTATOMIDÆ.

Sub-fam. Tessaratominæ.

Genus TESSARATOMA.

Tessaratoma, Lep. and Serv., Encycl. Meth., x, p. 590 (1825).
Type *T. papillosa*, Drury.

Tessaratoma kinta, sp. nov. (Pl. x, figs. 8, 8a, 8b.)

Head, pronotum and scutellum stramineous; lateral margins of head and apex of scutellum black; abdomen above black; body beneath stramineous; head beneath, rostrum, disk of prosternum, margins (more or less contentious) of meso- and metasterna, legs, and three longitudinal series of transverse segmental spots (one largest and central and one on each lateral margin) black; corium stramineous; membrane very pale stramineous; wings piceous-black, the costal and basal areas pale ochraceous; antennæ black, second and third joints subequal in length (remainder mutilated in all the specimens now before me); rostrum passing the anterior

coxæ; pronotum with the anterior angle subquadrately ampliate and moderately reflexed, these ampliated areas coarsely wrinkled, remaining surface finely punctate, the anterior marginal area wrinkled and punctate: scutellum finely and sparingly punctate, the black apex foveately depressed and somewhat obscurely centrally ridged: connexivum with the posterior angles of the segments acutely produced; metasternal process compressed, elevated, its apex rounded and reaching the anterior coxæ; posterior femora with two long apical spines beneath; corium densely, finely, obscurely punctate; membrane moderately passing the abdominal apex.

Long. excl. hemelytra, ♂ and ♀, 29 to 30 mm. Breadth between pronot. angl. 16 mm. Exp. hemelytra 65 mm.

Hab.—Malay Peninsula; Perak (Doherty).

I possess four specimens (3 ♂ ♂, 1 ♀) of this exceedingly well-marked species which in the structure of the pronotum is allied to *T. quadrata*, Dist., from which it differs by its smaller size, different shape of the metasternal process, and the peculiar markings and coloration of the body beneath; from *T. malaya*, Stål, it is separated by the different structure of the pronotum, the different colour of the abdomen above, smaller size and the distinct markings of the body beneath. In the specimen figured the antennæ were completely mutilated.

Tessaratoma kina, sp. nov. (Pl. x, figs. 11, 11a, 11b.)

Head, pronotum and scutellum bright shining ochraceous; lateral margins of head, antennæ and apex of scutellum black; abdomen above black, the connexivum castaneous; body beneath, rostrum and legs piceous; prosternum ochraceous with discal piceous shadings; corium bright ochraceous, membrane pale ochraceous; wings pale bronzy, subhyaline, the basal area stramineous; antennæ with the second and fourth joints subequal in length, each a little longer than the third; rostrum reaching the anterior coxæ; pronotum with the anterior angles subquadrately ampliate, these ampliated areas coarsely wrinkled, remaining surface finely, sparingly punctate, the anterior marginal area somewhat transversely wrinkled; scutellum finely, obscurely punctate, the black apex broadly, longitudinally foveate; connexivum with the posterior segmental angles acute; metasternal process compressed, moderately directed upwardly, its apex rounded and reaching the anterior coxæ; rostrum reaching the intermediate coxæ; posterior femora with two long apical spines beneath; corium densely, finely punctate.

Long. excl. hemelytra, ♀, 28 mm. Breadth between pronot. angl. 14½ mm. Exp. hemelytra 62 mm.

Hab.—Borneo; Kina Balu (Whitehead; Coll. Dist.).

Allied to *T. kinta* but differing by the more upturned metasternal process, second joint of antennæ longer than third, the

castaneous connexivum, narrower pronotum, and different colour and markings of the body beneath.

In the figure the abdomen is a little too elongate.

Fam. LYGÆIDÆ.

Genus MACROPES.

Macropes, Motsch., Et. Ent., viii, p 108 (1859).
Type *M. spinimanus*, Motsch.

Macropes philippinensis, sp. nov. (Pl. xi, figs. 7, 7a.)

Head, pronotum, scutellum, abdomen above, body beneath and legs black; first and second joints of antennæ and the tarsi sordid ochraceous; abdomen beneath ochraceously pilose; hemelytra pale creamy yellow, base, central vein and outer margin of clavus, apical angular area of corium, base of membrane and a large discal spot, black; antennæ with the second and fourth joints subequal in length, each longer than third; rostrum passing the anterior coxæ; pronotum with the anterior lobe smooth, broad, convexly narrowed to head, centrally, finely, longitudinally sulcate, behind the sulcation broadly, transversely, opaquely granulose; membrane not quite reaching the apex of the fourth abdominal segment; scutellum apically, centrally, longitudinally carinate; anterior femora very strongly incrassated and strongly spinous beneath.

Long. 9 mm.

Hab.—Philippine Islands (C. S. Banks; Brit. Mus.).

Fam. TINGIDIDÆ.

Genus ELASMOGNATHUS.

Elasmognathus, Fieb., Ent. Monogr., pp. 30 and 90 (1844).
Type *E. helferi*, Fieb.

Elasmognathus picturatus, sp. nov. (Pl. x, figs. 4, 4a.)

Head piceous, greyishly pilose; antennæ pale ochraceous, the apical joint (excluding base) piceous, first and second joints brownish; pronotum castaneous, the anterior vesicle or hood and the produced lateral areas dull greyish white, the margins of the areolets darker; hemelytra with the discoidal and subcostal areas pale tawny, an oblique central line to the first and the margins of the latter castaneous-brown; costal area very pale stramineous with a dark castaneous spot beyond middle and a larger spot of the same colour at apex; sutural area greyish-brown; body beneath castaneous, thickly, greyishly pilose; legs pale ochraceous; first and second joints of antennæ strongly incrassate, fourth longer than first and second together; pronotum with the anterior hood

scarcely covering base of head, globosely erect and anteriorly convexly rounded and a little bent forwardly, the lateral areas globosely erect and a little obliquely directed outwardly, very distinctly areolate and the margins of the areolets raised and prominent; the disk reticulately granulose, tricarinate, the central carination straight and procurrent, the lateral carinations largely concealed by the produced lateral areas; hemelytra, with the areolets of the discoidal and sutural areas, small and dense, those of the latter more obscure; costal area with most of the areolets moderately large and subquadrate.

Long. 4½ mm.
Hab.—Borneo; Kuching (Hewitt).

Genus Teleonemia.

Teleonemia, Costa, Ann. Mus. Zool. Napoli, ii, p. 144 (1864).
Type *T. funerea*, Costa.

Teleonemia bimaculata, sp. nov. (Pl. x, figs. 6, 6a.)

Head and pronotum fuscous-brown; the first with a paler mark behind each eye, the latter with a transverse black spot palely margined on each side near anterior margin which is narrowly ochraceous; hemelytra with the discoidal and subcostal areas pale brownish ochraceous, the margin of the areolets a little darker, the discoidal area with two large piceous spots, one at base, the other at apex, the latter more palely and broadly continued across the subcostal and costal areas; costal area greyish with the margins of the areolets fuscous and with a piceous spot at apex; sutural area greyish brown near base, pale greyish near apex, margins of the areolets piceous; body beneath piceous, greyishly pilose, abdominal apex greyish white; legs piceous-brown; antennæ fuscous-brown, first and second joints incrassate, first a little longer than second, fourth longer than first and second together; pronotum coarsely punctate, tricarinate, the central carination straight and procurrent, the lateral carinations very short and oblique, an obscure transverse impression at their anterior termination, the apex, posterior lateral margins and the lateral carinations paler in hue; hemelytra with the discoidal area coarsely punctate, subcostal area with small areolets arrayed in longitudinal series, costal area with irregular subquadrate areolets, sutural area with the apical areolets considerably larger than those near base.

Long. 4½ mm.
Hab.—Borneo; Kuching (Hewitt).

Teleonemia borneenis, sp. nov. (Pl. x, figs. 1, 1a.)

Piceous-black; tibiæ brownish testaceous; antennæ with the first and second joints moderately incrassate, first joint longer than

second, fourth longer than first and second together; pronotum strongly, transversely compressed near anterior margin, coarsely punctate, its apex very coarsely punctate, the central longitudinal carination strongly and acutely raised, the lateral carinations more obscure but also procurrent and sinuate, the anterior marginal area robustly granulate; hemelytra densely areolate, the areolets of the sutural area larger than those found on the remaining areas.

Long. 4 mm.
Hab.—Borneo; Kuching (Hewitt).

Teleonemia (?) *elegantula*, sp. nov. (Pl. x, figs. 3, 3a.)

Head pale bluish grey, eyes dark indigo-blue; antennæ brownish, first, second and fourth joints darker; pronotum indigo-blue, the lateral margins and anterior area greyish white, the hood ochraceous; hemelytra with the discoidal and subcostal areas pale bluish, a large dark indigo-blue spot occupying the central disks of both; costal and sutural areas greyish, hyaline, the margins of the areolets brownish, the basal portion of the sutural area pale bluish; body beneath greyish blue; legs pale castaneous-brown; antennæ with the first and second joints incrassate, first longer than second, fourth longer than first and second together; pronotum with the anterior vesicle or hood somewhat compressed and pointed in front, areolate, scarcely covering base of head, globose and strongly depressed near middle, tricarinate, the lateral carinations a little sinuate and not reaching the pale anterior area, thickly punctate, more coarsely so posteriorly; hemelytra with the discoidal and subcostal areas coarsely punctate, the costal and sutural areas areolate, the costal distinctly widened beyond middle.

Long. 3½ to 4 mm.
Hab.—Borneo; Kuching (Hewitt).

Sub-order HOMOPTERA.

Fam. FULGORIDÆ.

Sub-fam. Lophopinæ.

Genus MAKOTA, gen. nov.

Head a little longer than space between eyes, the lateral margins strongly ridged, the apex angulate; face with its base produced above eyes, dilated on each side before clypeus near which it is obliquely directed inwardly, centrally tricarinate, the central carination straight, the lateral carinations more roundly oblique; clypeus centrally carinate; pronotum broad, short, tricarinate, anteriorly a little produced between the eyes; mesonotum large, tricarinate, the carinations continuous with those of the pronotum, the lateral ones oblique; rostrum almost reaching the

posterior coxæ; tegmina not quite three times as broad as long, the costal and posterior margins almost straight and parallel, the apex truncate, the veins longitudinal, those on the apical area dense and numerous, the costal area with numerous slightly oblique transverse veins beyond middle; wings with a subapical series of small, fine, transverse veins; anterior and intermediate tibiæ strongly dilated, posterior tibiæ not dilated, sulcate beneath, with two strong spines beyond middle; basal joint of posterior tarsi long and thickened.

Type *M. illustris*, Dist.

Makota illustris, sp. nov. (Pl. xi, figs. 6, 6a.)

Vertex of head, pronotum and scutellum ferruginous-brown; apex of vertex lateral margins of pronotum and apex of mesonotum, ochraceous; abdomen above dull brownish ochraceous; face, sternum and legs dull ochraceous; legs spotted and mottled with fuscous, apices of the posterior tibiæ and tarsi piceous; abdomen beneath ferruginous-brown, more or less mottled with piceous; tegmina hyaline, the basal third, apical fourth, and claval area brownish ochraceous with piceous spots and mottlings, the opaque apical area with a hyaline spot near apex on the costal and posterior margins containing small piceous spots, and an apical hyaline margin without spots, the veins on the central hyaline area spotted with piceous, posterior margin of claval area thickly spotted with piceous; wings hyaline, apical and posterior margins broadly fuscous; structural characters as in generic diagnosis.

Long. excl. tegm. 10 mm. Exp. tegm. 26 mm.
Hab.—Borneo; Kuching (Hewitt).

Makota notabilis, sp. nov. (Pl. xi, figs. 1, 1a.)

Vertex of head ochraceous, with the lateral margins at the region of the eyes black; pronotum black, the carinæ and broad lateral margins ochraceous, some fine linear ochraceous spots near basal margin; mesonotum piceous; clypeus, sternum and abdomen beneath more or less piceous; face, legs and lateral spots to abdomen ochraceous; legs spotted with piceous, margins of femora and apices of tibiæ and tarsi black; tegmina pale ochraceous subhyaline, basal fourth, apical third, and claval area black, a pale ochraceous subhyaline spot near apex on the costal and posterior margins containing small piceous spots and an apical subhyaline margin without spots, the veins on the central pale area spotted with black.

Long. incl. tegm. 13 mm.
Hab.—Borneo; Kuching (Hewitt).

Allied to *M. illustris* but differing in the less developed anterior tibiæ, the more acutely posteriorly widened face, the piceous clypeus, darker coloration, etc.

Genus ALUMA, gen. nov.

Vertex about as long as breadth between eyes, the lateral margins strongly ridged and a little angulate on each side at their apices; face long, much longer than clypeus, the base produced beyond eyes, gradually widened towards clypeus before which it is again bent inwardly, tricarinate, the lateral carinations very robust; clypeus centrally carinate; rostrum passing the intermediate coxæ; anterior and intermediate tibiæ dilated, posterior tibiæ not dilated and armed with two strong spines beyond middle, the apical spines well developed; basal joint of posterior tarsi long and strongly thickened; tegmina about three times as long as broad, the costal area with oblique transverse veins, veins on remaining surface longitudinal, on apical area dense and numerous, with numerous short transverse veins, and a distinct subapical transverse series defining a short subapical area, costal margin moderately sinuate, apex slightly rounded, inner margin a little dilated beyond claval apex; pronotum short and broad, centrally tricarinate, its apex moderately produced between eyes, its lateral angles subacute; mesonotum broader than long, tricarinate, the carinations continuous with those on pronotum.

Type *A. ocellata*, Dist.

The shape and venation of the tegmina as well as the structure of the face will distinguish this genus from *Makota*, to which it is allied.

Aluma ocellata, sp. nov. (Pl. xi, figs. 3, 3a.)

Body above and tegmina black; body beneath and legs piceous, the anterior and intermediate tibiæ above obscurely banded with black; tegmina with a large subapical ocellate spot, black, margined with reddish brown and with a small white pupillate spot situate nearer its hinder extremity, a few scattered obscure greyish spots near middle of costal area; tarsi and disk of sternum brownish ochraceous; structural characters as in generic diagnosis.

Long. incl. tegm. 14 mm.

Hab.—Borneo; Kuching (Hewitt).

Genus SAREBASA, gen. nov.

Head a little longer than breadth between eyes, a bent transverse impression between the eyes, in front of which are two prominent ridges gradually directed outwardly, the lateral margins in front of eyes raised and acute, their apices, with those of the two central ridges, having the appearance of four short spines in transverse series; posteriorly the head is a little narrowed between the eyes, widened anteriorly and apically subtruncate; face with its base projecting above the eyes where it is narrowest, and then gradually widened to a little before clypeus to which it is again inwardly directed, tricarinate, the central carination straight, the

lateral carinations parallel to the lateral margins; clypeus about as long as face, centrally carinate; rostrum reaching the posterior coxæ; pronotum short and broad, strongly narrowed from basal angles (which are subprominent) to between eyes, the apical margin rounded, basal margin truncate, tricarinate on disk, the central carination straight, the two lateral carinations ronnded and meeting in front; mesonotum broad, tricarinate; femora moderately broad and flattened, beneath strongly, longitudinally ridged; anterior tibiæ moderately dilated, posterior tibiæ widened from base to apex which is broad and snbtruncate; two prominent spines, one near base, the other near apex; basal joint of the posterior tarsi broadly thickened, longer than remaining joints together; tegmina more than twice as long as broad, costal margin rounded, apex broad, truncately rounded, posterior margin widened and rounded beyond claval apex, costal area obliquely veined, remaining veins longitudinal, dense and numerous on apical half.

Type *S. celebris*, Dist.

Sarebasa celebris, sp. nov. (Pl. xi, figs. 11, 11a.)

Vertex pale luteous, the lateral margins in front of eyes with black ringlets; pronotum fuscous-brown, the anterior and lateral margins and a series of small spots at basal margin pale luteous; mesonotum and abdomen above fuscous-brown, the latter with the segmental margins pale; face pale luteous, its lateral areas with transverse black spots, its central area with two transverse black spots; clypeus black; body beneath and legs fuscous-brown or piceous; sides of face, spots to anterior and intermediate tibiæ, the posterior tibiæ excluding apices and margins of the abdominal segments beneath, pale luteous; tegmina pale greyish ochraceous, transversely shaded with piceous as shown in figure; wings hyaline, the veins and broad apical and outer margins fuscons; structural characters as in generic diagnosis.

Long. excl. tegm. 9 mm. Exp. tegm. 23 mm.

Hab.—Malay Peninsula; Selangor (H. E. Durham; Brit. Mus.).

Genus APIA, gen. nov.

Vertex about as long as breadth between eyes, the apical margin rounded and slightly angulated on each side; face long, truncate at base, gradually and slightly widened towards clypeus before which it is narrowed on each side; rostrum mutilated in typical specimen; pronotum short and broad, tricarinate, the central carination straight, the lateral carinations meeting in front of it, anteriorly conically produced between the eyes; mesonotum large, broad, tricarinate, the central carination straight, the lateral carinations oblique; abdomen above centrally ridged, the ridge appearing dentate by the compression of the abdominal segments; legs of moderate length and size, anterior tibiæ slightly but not prominently dilated, posterior tibiæ with two spines somewhat

close together, a little beyond middle; tegmina nearly three times as long as broad, the costal area obliquely veined, remaining venation longitudinal, becoming dense and close towards apical area.

Type *A. lineolata*, Dist.

Apia lineolata, sp. nov. (Pl. xi, figs. 10, 10a.)

Head, pronotum and scutellum ochraceous, with longitudinal piceous lines, five on vertex of which three are discal and two marginal, ten on pronotum and about the same number on mesonotum; abdomen dark brownish, the segmental margins piceous; body beneath and legs ochraceous, face, with the margins and seven longitudinal lines, piceous; legs with piceous longitudinal lines; tegmina ochraceous mottled with greyish, costal area beyond basal third greyish with oblique fuscous lines, the longest crossing apical area, two transverse and bent almost parallel with apical margin, a piceous subapical spot near posterior margin; wings pale fuliginous, posterior and apical margins broadly fuscous; structural characters as detailed in generic diagnosis.

Long. excl. tegm. 8 mm. Exp. tegm. 24 mm.

Hab.—Malay Peninsula; Singapore (H. N. Ridley; Brit. Mus.).

Genus VARMA.

Varma, Dist., Faun. Brit. Ind. Rhynch., iii, p. 330 (1906).
Type *V. fervens*, Walk.

Varma obliqua, sp. nov. (Pl. xi, figs. 8, 8a.)

Vertex, pro- and mesonota, face, sternum and legs pale ochraceous; abdomen brownish ochraceous, above marginally and centrally castaneous; tegmina subhyaline, the costal and apical areas, claval margins, and an oblique fascia before the apical area dull ochraceous, above the fascia on costal margin is a small piceous spot; wings hyaline, the veins and apical area dull ochraceous; face with the central and lateral carinations robust and much darker in hue, as is also the central carination to the clypeus, posterior tibiæ with two strong spines beyond middle, preceded by a shorter and almost obsolete spine.

Long. excl. tegm. 6 mm. Exp. tegm. 18 mm.

Hab.—Malay Peninsula; Perak (Doherty).

Genus SERIDA.

Serida, Walk., Journ. Linn. Soc. Lond. Zool., 1, p. 158 (1857).
Type *S. latens*, Walk.

Serida balteata, sp. nov.

Vertex, pronotum and mesonotum piceous; basal margin, central and marginal ridges to vertex; lateral margins, central

carinations and longitudinal lines and spots on each lateral area of pronotum, central carinations, lateral margins, apex, irregular fasciæ on lateral areas and the margins of two small, dark, subapical spots to mesonotum, ochraceous; face, sternum and legs ochraceous; a central longitudinal fascia to face and clypeus, lateral margins of prosternum, a small apical and subapical spot to femora beneath and a spot behind eyes, black; abdomen mutilated in the two typical specimens now before me; tegmina hyaline, the veins, basal third of costal area attached to a transverse fascia which extends through corium and clavus, large suffusions on apical area which principally take the form of two transverse fasciæ fused internally and forming a large x-shaped spot, apical margin and posterior claval margin piceous-brown; wings hyaline, apical margins broadly piceous-brown; vertex longer than broad, the ridges prominent; face sub-angulately broadened beyond middle.

Long. incl. tegm. 11 mm.
Hab.—Cambodia (Mouhot; Brit. Mus.).

Genus CATARA.

Catara, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 115 (1868).
Type *C. subdivisa*, Walk.

Catara subdivisa.

Catara subdivisa, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 115 (1868).
Serida proxima, Walk., *loc. cit.*, p. 183 (1868).
Hab.—Morty Islds; Batchian (Doherty).

Catara philippinensis, sp. nov. (Pl. xi, figs. 12, 12a.)

Body above and abdomen beneath more or less ferruginous-brown; face, sternum and legs brownish ochraceous; tegmina brownish ochraceous, the base of costal area piceous, remainder of costal area, the apical area, and two transverse fasciæ somewhat at right angles to each other fuscous-brown; wings hyaline, slightly fuliginous, the veins fuscous; vertex broader than long, centrally and marginally ridged; pronotum narrow, strongly anteriorly produced in front of eyes, posteriorly deeply angularly sinuate, all the margins ridged and with a prominent central longitudinal carination; mesonotum long, tricarinate; face elongate, the margins ridged, centrally longitudinally carinate, its base conderably above eyes and truncate, gradually widened towards clypeus before which it is obliquely turned inwardly; clypeus short and centrally carinate; rostrum reaching the posterior coxæ; posterior tarsi with two spines somewhat close together beyond middle; tegmina with the costal area obliquely veined, a curved transverse vein defining a closely longitudinally veined apical area, before which is another series of irregular transverse veins.

Long. excl. tegm. 7 mm. Exp. tegm. 18 mm.

Hab.—Philippine Islds. (C. S. Banks; Brit. Mus.).

Allied to *C. subdivisa*, Walk., but differing by the shorter pronotum, different markings to the tegmina, etc.

Genus JIVATMA.

Jivatma, Dist., Faun. Brit. Ind. Rhynch., iii, p. 328 (1906). Type *J. metallica*, Dist.

Jivatma insignis, sp. nov. (Pl. xi, figs. 9, 9a.)

Vertex stramineous, the margins and those of the central carination brownish; pro- and mesonota ferruginous-brown, the latter between the carinations piceous; abdomen ferruginous-brown, sternum and legs brownish ochraceous; face and clypeus stramineous; tegmina umber-brown, the costal area with whitish transverse linear spots or stripes, a greyish white patch extending round costal and apical margins containing five brown streaks, of which three are outwardly oblique, one inwardly oblique and the fifth longitudinal, a small black spot near posterior angle; wings pale fuliginous, the veins darker; vertex centrally and marginally carinate; face tricarinate; clypeus with the central carination fine but distinct; rostrum about reaching the posterior coxæ; pro- and mesonota tricarinate; posterior tibiæ with three spines, two beyond middle and one at apex.

Long. excl. tegm. 6 mm. Exp. tegm. 19 mm.

Hab.—Borneo; Kuching (Hewitt).

Jivatma whiteheadi, sp. nov.

Vertex, pronotum and mesonotum brownish ochraceous, pronotum and mesonotum with two broad longitudinal piceous fasciæ only separated by the pale central longitudinal carination and outwardly defined by the lateral carination on each side, on mesonotum these fasciæ do not extend to the posterior apex; abdomen above and beneath more or less piceous; face, sternum and legs ochraceous; tegmina pale ochraceous, the costal area from base to beyond middle more or less greyish subhyaline with very obscure obliquely transverse ochraceous lines, beyond this pale area are five greyish subhyaline lines, commencing on costa and scarcely reaching middle of tegmen, the first three oblique, the fourth and fifth straightly transverse, the fifth subapical; proceeding from the outer angle of the posterior margin are two or three similar but shorter lines, the apical margin is more obscure greyish, and near the posterior angle is a black faintly ocellate spot outwardly margined with reddish ochraceous; wings pale fuliginous, a little darker at apex; vertex slightly longer than breadth between eyes, centrally and laterally strongly ridged; face with the angles before clypeus rather strongly produced, making the breadth there almost equal to the length.

Long. excl. tegm. 5½ mm. Exp. tegm. 20 mm.
Hab.—Philippine Islds. (Whitehead; Brit. Mus.).

Genus LOPHOPS.

Lophops, Spin., Ann. Soc. Ent. Fr., viii, p. 387 (1839).
Cystinocephala, Stål, Öfv. Vet.-Ak. Förh., 1853, p. 266.
Gozarta, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 116 (1868).
Type *L. servillei*, Spin.

Lophops zebra.
Gozarta zebra, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 116 (1868).
Hab.—Malay Archipelago; Tidor[1] (Wallace); Malay Peninsula; Selangor (Durham; Brit. Mus.).

Fam. CERCOPIDÆ.

Sub-fam. Aphrophorinæ.

Genus PTYELUS.

Ptyelus, St. Farg. and Serv., Enc. Meth., x, p. 608 (1825).
Philænus, Stål, Stett. Ent. Zeit., xxv, p. 66 (1864).
Amarusa, Walk., Journ. Linn. Soc. Lond. Zool., 1, p. 166 (1857).
Type *P. flavescens*, Fabr.

Ptyelus piceus.
Amarusa picea, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 166 (1857).
Ptyelus tenebrifer, Walk., List Hom. Suppl., p. 189 (1858).
Hab.—Borneo.

Genus PLINIA.

Plinia, Stål, Hem. Afr., iv, p. 66 (1866); *Id.*, Berl. Ent. Zeitschr., x, p. 384 (1866).
Type *P. ampla*, Walk.

Plinia pilosa, sp. nov. (Pl. x, figs. 12, 12a.)

Black, thickly brownly pilose, tegmina more thickly and longly pilose, the hairs being arranged in tufts; vertex distinctly shorter than pronotum, somewhat conically rounded in front of eyes; face somewhat long and prominent, centrally a little flattened where there is a central longitudinal raised line, the lateral areas strongly, transversely striate; clypeus with a central longitudinal raised line which is widened posteriorly but does not reach apex; rostrum reaching the intermediate coxæ; posterior femora with two strong spines; tegmina very strongly and broadly wrinkled on the claval area.

[1] By a misprint in Walker's paper this locality reads "Tidon."

Long. 15 mm.

Hab.—S.-E. Borneo (Doherty; Coll. Dist.).

Allied to *P. ampla*, Walk., but differing by the shorter vertex, which in *ampla* is as long as the pronotum, very much more strongly pilose, claval area strongly wrinkled, and by the absence of the red margin to vertex as in *P. ampla*.

Genus CLOVIA.

Clovia, Stål, Hem. Afr., iv, p. 75 (1866).

Type *C. bigoti*, Sign.

Clovia humboldtiana, sp. nov. (Pl. x, figs. 7, 7a.)

Black or piceous; a central longitudinal stramineous fascia traversing the vertex, pronotum and scutellum; tegmina with six stramineous spots situate two in clavus—one at base elongate, the other near middle transversely oblique—and four on coriaceous area—two near costal margin and two on apical area; face and legs brownish, the posterior legs sometimes piceous; lateral and basal margins of face and a longitudinal fascia on each side of sternum, stramineous; vertex subequal in length to pronotum, anteriorly somewhat obtusely, roundly, angularly produced, and with an obscure, fine, transverse impression on disk; vertex, pronotum and scutellum finely punctate, the pronotum also very finely wrinkled; face flattened though very slightly convex; posterior tibiæ with two spines; tegmina densely, finely punctate.

Long. 8 to 9 mm.

Hab.—New Guinea; Humboldt Bay (Doherty; Brit. Mus.).

Allied to *C. ornata*, Walk.

Clovia moresbyensis, sp. nov. (Pl. x, figs. 9, 9a.)

Vertex, pronotum and scutellum piceous-brown; vertex with a narrow, black, marginal line in front of eyes, this line inwardly broadly margined with dull ochraceous; pronotum with a narrow transverse pale yellow line before middle; face, abdomen beneath and legs pale castaneous-brown; sternum piceous; basal and lateral margins of face, a submarginal fascia on each side of sternum, apex of clypeus, under surfaces and apices of femora and abdominal segmental margins, ochraceous; tegmina piceous-brown, an oblique spot before middle of clavus not reaching claval suture and extending over its inner margin a short way into the corium, and two small spots in oblique series on apical area pale ochraceous; vertex about as long as pronotum, obtusely, angularly produced anteriorly; rostrum reaching the intermediate coxæ; vertex, pronotum and scutellum very finely, transversely wrinkled; tegmina obscurely, densely, finely punctate; posterior tibiæ with two spines.

Long. 11 mm.
Hab.—New Guinea; near Port Moresby.
Allied to *C. varipes*, Walk.

Clovia pilosula, sp. nov. (Pl. x, figs. 10, 10a.)

Vertex, pronotum and scutellum obscure ochraceous, sometimes brownish; vertex very narrowly margined with black in front of eyes, and with a short, central, transverse, dark line on disk; pronotum with six darkly impressed spots near anterior margin, face and scutellum black; sternum, legs and abdomen beneath more or less brownish ochraceous; basal and lateral margins of face, and a broad sublateral fascia on each side of sternum, golden yellow; apices of posterior tibiæ and the posterior tarsi piceous; tegmina piceous-brown, pilose; clavus (excluding apex) obscure ochraceous; a short oblique fascia crossing clavus beyond middle but not extending to middle of corium, extreme apex of clavus, and an oblique curved fascia extending from costal margin at commencement of apical area and extending to apex, pale dull ochraceous; vertex almost as long as pronotum, obtusely, angularly rounded anteriorly; rostrum reaching the intermediate coxæ; vertex, pronotum and scutellum very finely wrinkled; tegmina densely, finely pilose; posterior tibiæ with two spines.

Long. 10½ to 12 mm.
Hab.—S.-E. Borneo (Doherty).

Clovia batchianensis, sp. nov.

Vertex, pronotum and scutellum pale ochraceous, vertex and pronotum with darker longitudinal lines of which two are central and procurrent, and on each side of these are one on vertex and two on pronotum, some linear spots on scutellum (imperfectly seen in type owing to the specimen being pinned in that locality), body beneath and legs pale brownish ochraceous; a narrow basal line to face, apices of tarsi and apices of the posterior tibiæ black; tegmina brownish, pilose, an oblique macular fascia crossing base of clavus to costal margin before middle, and an obscure discal oblique suffusion, and two oblique linear spots on apical area—the uppermost at about one-third from apex and the other on apical costal margin—pale ochraceous; vertex a little shorter than pronotum, obtusely angularly rounded in front; rostrum reaching the intermediate coxæ; upper surface more or less shortly, finely pilose, the tegmina more densely and longly pilose; posterior tibiæ with two spines.

Long. 9 mm.
Hab.—Batchian Island (Doherty).

Clovia signifera.
Perinoia signifera, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 166 (1857).
Hab.—Borneo.

Clovia expressa.
Perinoia expressa, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 167 (1857).
Hab.—Borneo.

Clovia exclamans.
Perinoia exclamans, Walk., Journ. Linn. Soc. Lond. Zool., i, p. 166 (1857).
Hab.—Borneo.

Clovia ornata.
Perinoia ornata, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 294 (1869).
Hab.—Dorey, New Guinea.

Clovia deflexa.
Perinoia deflexa, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 295 (1869).[1]
Hab.—Mysol (Wallace); New Guinea, Humboldt Bay (Doherty).

Clovia disjuncta.
Perinoia disjuncta, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 295 (1869).
Hab.—Dorey, New Guinea.

Clovia subjuncta.
Perinoia subjuncta Walk., Journ. Linn. Soc. Lond. Zool., x, p. 295 (1869).
Perinoia placens, Walk., *loc. cit.*, p. 296.
Var. Perinoia *semijuncta*, Walk., MS.
Hab.—Philippines; N. Luzon (Brit. Mus.), Amboina, Aru, Mysol, Batchian, Morty, New Guinea (Wallace; Brit. Mus.).

Two specimens labelled *semijuncta*, Walk., are contained in the British Museum, but I can find no trace of a description. It appears to be a variety of *C. subjuncta*, Walk., from which it differs by the following characters in coloration: The face is ochraceous, not black, but with the same stramineous margination; the transverse black band to the pronotum is broader; and the apical pale margin to the tegmina is not continuous to the claval apex, but terminates at the inner apical angle.

Clovia furcata.
Perinoia furcata, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 297 (1869).
Perinoia furcifera, Walk., *loc. cit.*
Hab.—Sula, Ceram.

[1] *Perinoia separata*, Walk. (*loc. cit.*, p. 294), seems, from the description, to be closely allied to this species, but the type is no longer to be found, and under these circumstances I regard it as a non-existent species. Kirkaldy (Trans. Ent. Soc. Lond., 1905, p. 330) comparatively refers to *separata*, Walk. This may, perhaps, be a slip of the pen.

Clovia subfurcata.

Perinoia subfurcata, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 298 (1869).

Hab.—Gilolo, Ternate (Wallace); Batchian (Doherty).

Clovia plena.

Perinoia plena, Walk., Journ Linn. Soc. Lond. Zool., x, p. 298 (1869).

Hab.—Sula.

Clovia lituriplena.

Perinoia lituriplena, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 296 (1869).

Hab.—Mysol.

Clovia varipes.

Perinoia varipes, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 300 (1869).

Hab.—Batchian.

Clovia comma.

Ptyelus comma, Walk., List. Hom. Suppl., p. 190 (1858).

Hab.—Sumatra.

Clovia transversa.

Perinoia transversa, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 299 (1869).

Perinoia pustuliceps, Walk., *loc. cit.*

Var. *Perinoia badia*, Walk., *loc. cit.*

Differs from the typical form by the absence of the luteous transverse line to the pronotum.

Hab.—Mysol, New Guinea, Aru.

Clovia plenipennis.

Ptyelus plenipennis, Walk., *Journ. Linn. Soc. Lond. Zool.*, x, p. 293 (1869).

Ptyelus frontalis, Walk., *loc. cit.*

Hab.—New Guinea, Aru.

Genus PHILAGRA.

Chalepus, Walk., List. Hom., iii, p. 731 (1851), *nom. præocc.*
Philagra, Stål, Trans. Ent. Soc. Lond. (iii), i, p. 593 (1862).
Type *P. hastata*, Walk.

Philagra cephalica, sp. nov. (Pl. x, figs. 5, 5a, 5b.)

Head, pronotum, scutellum, sternum and legs fuscous-brown, very finely, greyishly pilose; abdomen above and beneath shining black; lateral margins of meso- and metasterna broadly ochraceous; bases of the posterior tibiæ brownish ochraceous; tegmina pale castaneous-brown, thickly mottled with obscure, irregular reddish spots; wings pale fuliginous, the veins black, the costal area hyaline; head longly produced, the vertex more than twice as long as pronotum, centrally longitudinally ridged, the lateral

margins also ridged; pronotum with a central, longitudinal, incised line on disk, on each side of which, a little before middle, is a distinct foveate impression; face with a central longitudinal ridge; rostrum reaching the intermediate coxæ; posterior tibiæ with two spines, the basal spine shortest.

Long. excl. tegm. 16 mm. Exp. tegm. 29 mm.
Hab.—Cambodia (Mouhot; Brit. Mus.).

Philagra provecta, sp. nov. (Pl. xi, figs. 5, 5a, 5b.)

Head above, pronotum and scutellum black, thickly, finely, shortly, greyishly pilose; abdomen above and body beneath black and less pilose; apex of produced vertex, apex of scutellum, base of face, lateral margins of sternum, and the legs, brownish ochraceous; tegmina brownish ochraceous with piceous suffusions; wings hyaline with an ochraceous tint, the veins brownish ochraceous; head about as long as pronotum and scutellum together, somewhat evenly and parallelly produced from about one-third in front of eyes, curved upwardly; three short longitudinal impressions on anterior area of pronotum; abdomen above shining black, the apical area more piceous-brown; face finely, transversely wrinkled; posterior tibiæ with two prominent spines.

Long. excl. tegm. 12 mm. Exp. tegm. 22 mm.
Hab.—Sangir (Doherty).

Sub-fam. Cercopinæ.

Genus EOSCARTA.

Eoscarta, Bredd., Soc. Ent., xvii, p. 58 (1902).
Type *E. borealis*, Dist.

Eoscarta rana, sp. nov. (Pl. x, figs. 2, 2a.)

Body and legs piceous-black, the upper surface of the abdomen shining; almost the posterior half of the pronotum, but not extending to the lateral angles, flavescent; tegmina flavescent, the basal third piceous-black; wings hyaline, the basal area infuscate; face longitudinally and somewhat broadly sulcate; vertex about as long as breadth between eyes, rather angularly rounded in front; pronotum densely, finely punctate and faintly transversely wrinkled; scutellum distinctly centrally, roundly foveate; tegmina somewhat granulosely wrinkled; posterior tibiæ with a somewhat long spine.

Long. excl. tegm. 6½ mm. Exp. tegm. 18 mm.
Hab.—Borneo; Kuching (Hewitt).

Eoscarta monostigma.
Ptyelus monostigma, Walk., Journ. Linn. Soc. Lond. Zool., x, p. 293 (1869).
Ptyelus impressus, Walk., *loc. cit.*, p. 294.

Ptyclus concolor, Walk., MS.
Hab.—Morty Island, New Guinea.

The *P. concolor*, Walk., MS., is not the species described by Walker under the same name in List Hom., iii, p. 715 (1851), the latter being a synonym of *Poophilus costalis*, Walk.

In this small species the longitudinal furrow is frequently indiscernible or almost so in certain specimens.

Fam. JASSIDÆ.

Sub-fam. Ledrinæ.

Genus LEDRA.

Ledra, Fabr., Syst. Rhyng., p. 24 (1803).
Type *L. aurita*, Linn.

Ledra muda, sp. nov. (Pl. xi, figs. 4, 4a.)

Ferruginous-brown; apical area of head, posterior two-thirds of pronotum and basal area of face obscure plumbeous; tegmina subhyaline, talc-like, the veins reddish brown, the basal area reddish brown followed by an obliquely transverse darker fascia; wings subhyaline and talc-like, the veins reddish brown; vertex little more in length than half the breadth between eyes, the disk finely granulate, coarsely granulate on apical area and somewhat coarsely so on lateral marginal areas, centrally longitudinally ridged, the ocelli a little nearer to each other than to eyes, and from each ocellus there is obliquely directed a short but distinct sharp impression; between ocelli and eyes is a small but distinct tubercle; pronotum with a subangulate transverse impression separating the narrow anterior paler area, the whole surface sparsely granulose, the granules larger and coarser towards base, on the posterior and darker area are four longitudinal ridges of which the two central are more distinct and granulose; scutellum finely, sparsely granulose, two prominent discal granules nearer to lateral margins than to each other; face broadly concave, rostrum reaching intermediate coxæ; anterior tibiæ moderately dilated, the margins longly, thickly pilose and sparsely granulose beneath, posterior tibiæ outwardly dilated, shortly, finely, obscurely serrate internally, externally widened beyond middle, shortly hirsute and with scattered short spines; tegmina with the basal opaque area punctate, with a few scattered granules and a few obscure pale spots.

Long. excl. tegm. 13 mm. Exp. tegm. 26 mm.
Hab.—Borneo; Kuching (Hewitt).

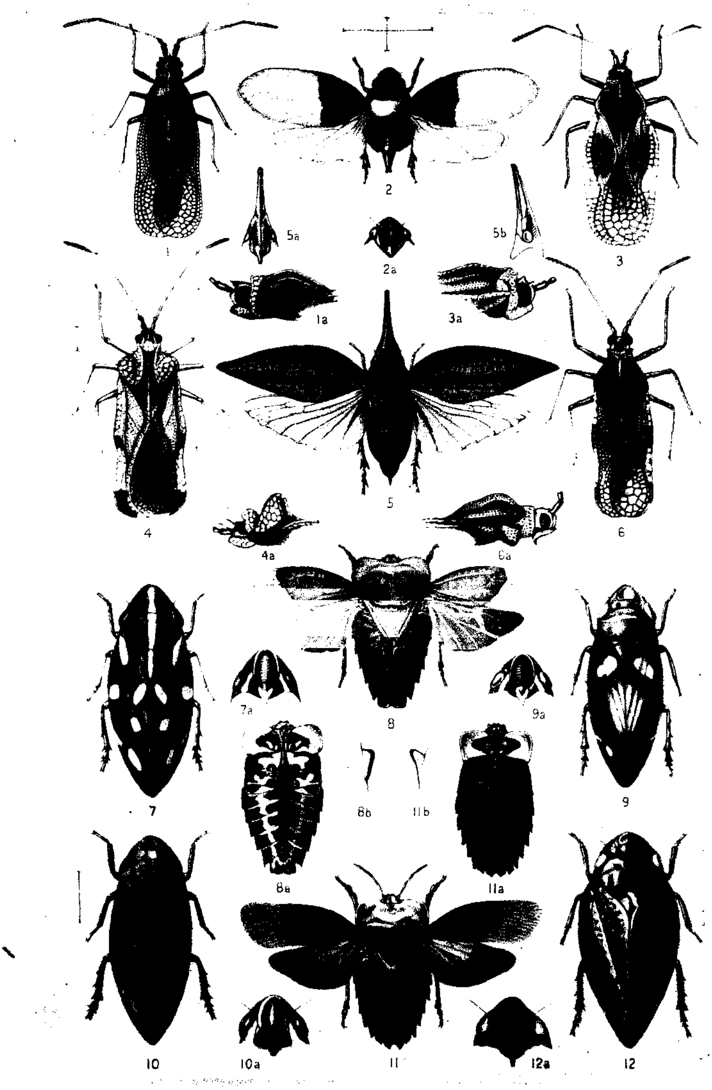
Ledra gigantea, sp. nov. (Pl. xi, figs. 2, 2a.)

Ferruginous-brown; tegmina with a piceous spot at inner margin near apex; wings subhyaline, talc-like, the veins ferruginous-brown; vertex about as long as space between eyes, coarsely

granulose except on basal area, ocelli a little nearer to each other than to eyes; pronotum not centrally longitudinally ridged, sparingly coarsely granulate, moderately raised before scutellum, the lateral margins moderately convex and finely dentate; scutellum finely punctate, a slight elongate elevation at apex; face broadly concave; rostrum mutilated in typical specimen; anterior tibiæ dilated, their outer margins longly pilose; posterior tibiæ broadly dilated, their outer margins hirsute, undulatory, dentate, narrowing towards base and apex, sparingly coarsely granulate; tegmina with the basal area punctate, with a few scattered granules, more abundant on basal third.

Long. excl. tegm., ♀, 28 mm. Exp. tegm. 46 mm.

Hab.—Borneo; Matang (Hewitt).



Horace Knight, del. West, Newman proc.

1. TELEONEMIA BORNEENSIS.
2. *EOSCARTA RANA.*
3. TELEONEMIA ?ELEGANTULA.
4. ELASMOGNATHUS PICTURATUS.
5. PHILAGRA CEPHALICA.
6. *TELEONEMIA BIMACULATA.*
7. CLOVIA HUMBOLDTIANA.
8. TESSARATOMA KINTA.
9. CLOVIA MORESBYENSIS.
10. „ *PILOSULA.*
11. TESSARATOMA KINA.
12. PLINIA PILOSA.

THE GENERIC NAME "INVESTIGATOR": A CORRECTION.

Since the publication of my memoir "*Investigator sicarius*, a Gephyrean worm hitherto undescribed, the type of a new order" (*Memoirs of the Indian Museum*, vol. i, No. 4, 1909), the fact has been brought to my notice that the name "Investigator" has already been appropriated. Goode and Bean in 1895 separated the species *Nemichthys acanthonotus*, Alcock, from the genus *Nemichthys*, and bestowed the name *Investigator* upon the new genus thus formed (Goode and Bean, *Oceanic Ichthyology*, p. 518). It may be noted that Alcock has not accepted this alteration (Alcock, *Descriptive Catalogue of the Indian Deep-Sea Fishes*, Calcutta, 1899). It is, however, necessary to find another name for the Gephyrean genus *Investigator*, and I therefore propose the Greek form of the same word, namely, *Ereunetes*.

Thus for Order Investigatoroidea read Order Ereunetoidea; for Genus *Investigator* read Genus *Ereunetes*; type *Ereunetes sicarius*.

CALCUTTA: F. H. STEWART.
June 7th, 1909.

XII. NOTES ON THE NEUROPTERA IN THE COLLECTION OF THE INDIAN MUSEUM.

By JAMES G. NEEDHAM.

The observations of the following pages are based on the study of a large series of miscellaneous Neuroptera belonging to the Indian Museum, sent to me by the Superintendent, Dr. Annandale, for study. With these were sent a considerable number of specimens from the collection of the Imperial Entomologist, Mr. Maxwell-Lefroy. Together, these specimens illustrate the greater part of the described Neuropterous fauna of the Indian empire. The entire known fauna in the Mantispidæ was represented: the smallest proportion of it was present in the Odonata.[1] This latter group has been collected a little more systematically perhaps than any other, but the specimens reside mainly in the collections of the European specialists who have described them, or in the British Museum.

Of the true Neuroptera (Neuroptera *s. str.*) most of the Indian forms have been described by three British naturalists: by Francis Walker, in the *Catalogue of Neuropterous Insects of the British Museum*, and in vol. v of the *Transactions of the Entomological Society of London*; by J. O. Westwood in his *Cabinet of Oriental Entomology*; and by Robert McLachlan in various scattered papers. Nearly all of Westwood's species are in the collection, including his *Ascalaphus obscurus*, a species long considered lost.

The Perlidæ of the collection are mostly new to science, which is not surprising, since but one species was known from the whole of India. The Odonata, Ephemeridæ, and Myrmeleonidæ of the collection are mostly well known, and in the Hemerobiidæ, Chrysopidæ, Ascalaphidæ, and Perlidæ occur the most interesting new forms and all the new genera.

In the collection were a few Termites which, for want of any knowledge of the group, I was compelled to return unnamed. And likewise, not knowing the Trichoptera, with Dr. Annandale's consent, I turned them over to Dr. C. Betten for study, and his report on them follows further on (p. 231). I have to express my gratitude to Dr. Annandale for his patience in waiting through the

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[1] By far the greater part of the collection of the Indian Museum was named some years ago by the late Baron de Sélys Longchamps, and therefore was not sent to Prof. Needham.—*N. Annandale*.

delays of sickness and change of location for the return of the specimens, and for this report upon them.

PERLIDÆ.

This is the most neglected of all the neuropteroid groups of the Indian fauna. Hitherto, apparently, there has been but one species of stone-fly described from the whole of India, and that one very imperfectly. It is the *Perla duvaucelii* of Pictet, known hitherto from a single specimen in the Museum of Paris. It is represented in the present collection by two male specimens, and with it are six other undescribed species. One of these is represented by a mere fragment: the other five are described herewith. Three are referred to *Perla* (*s. lat.*), one each to *Neoperla* and *Leuctra*, and one represents a new and very interesting genus with hairy eyes and greatly reduced labial palpi.

Perla benigna, sp. nov.

One male. Sikhim, E. Himalayas (Reg. No. $\frac{5994}{7}$).

Length 12 mm., with setæ 5 mm. or more additional, the tips perhaps broken. Expanse of wings 30 mm.

A brownish species with conspicuous yellow costal border to the fore wings. Head wider than the prothorax, and closely inserted into its flaring front end. Prothorax wider anteriorly, with rather straight fore border and sharp angles: hind angles more or less obtuse. Head blackish above, with an open W-mark directed backwards between the antennæ, the middle point of the W resting on the middle ocellus. Tubercles of the vertex yellow. Antennæ brown, the sides of the basal segment darker.

Prothoracic disc minutely pubescent, scarcely rugulose, fuscous in colour with a yellowish median line that is dilated anteriorly and runs out narrowly along the front border. Meso- and metathorax brown above and below and paler across the ends and along the sides. Abdomen yellowish, the three apical segments slightly darker. Legs yellow at the base, including two-thirds of the femora; beyond this brown. Setæ fuscous, concolourous, with dense pubescence and numerous stouter hairs; 15 segments present, measuring 5 mm., wings (pl. xix, fig. 1) brown, with a yellow costal band that is delimited behind by the main stem of the radial vein, except towards the base where it is a little wider; the veins in the yellow band are very indistinct. The venation is shown in plate xix, fig. 1.

The ninth segment of the abdomen (pl. xix, fig. 3) of the male is narrow upon the dorsal side and very wide below. On the mid-dorsal line (pl. xix, fig. 2) it is produced backward in a thin, flat, bifid triangular process. On the ventral side it is prolonged greatly, and upturned to enclose the tip of the abdomen. The upturned end is squarely truncated and margined with a rim-like

carina, beneath which is a conspicuous round callosity or tubercle, directed posteriorly. On the sloping sides of the apical margin of the ninth segment is another low carina which is decurrent at its junction with the posterior rim just described. The tenth segment is narrow and is mostly included. A pair of hooks arise from the inner side of the setæ, curving dorsally and then forward, with their tips opposed to the bifid dorsal process of the ninth segment (pl. xix, figs. 2, 3 and 4).

This is the largest species in the collection, and it is doubtless in life a rather handsome insect. It combines characters of the American genus *Acroneuria* with those of *Perla*, and will doubtless eventually be removed to a new genus.

Perla ione, sp. nov.

Eight males and five females. Kulu, W. Himalayas (Reg. Nos. $\frac{5838}{5}$, $\frac{6988}{7}$, $\frac{5831}{5}$, $\frac{5830}{5}$), also one of more recent collection by Dr. Annandale from Kurseong, probably of the same species, although the sides of the prothorax appear to be more convergent behind and the spot on the top of the head is more extensive. A specimen labelled Kurseong, E. Himalayas (Reg. No. $\frac{1556}{14}$), also appears to be the same.

An obscure brownish species, with scanty and indistinct markings. Length of male 11 to 15 mm., antennæ 8 mm. and setæ 5 to 6 mm. additional, and expanse of wings 33—35 mm. Length of female 15 mm. and expanse of wings 43—45 mm.

Head yellowish, with a diffuse fuscous spot between the ocelli (in the unnumbered specimen mentioned above, overspreading the ocelli in an obscure quadrate path). Antennæ fuscous. Body nearly uniform brownish. Legs yellowish brown, somewhat darker on the knees and tarsi. Wings subhyaline, with veins obscurely fuscous. Setæ yellowish.

The ninth abdominal segment is extended beneath posteriorly in a long scoop-shaped prolongation, which covers only the lower third of the end of the abdomen. Externally it is regularly convex and smooth without callosity, but with a more or less thickened rim across the upturned margin. The tenth segment is included below, but exposed and bifid above, divided into two high prominences, that are at first erect and then suddenly bent forward, ending in obtuse points, parallel and closely approximated (pl. xix, fig. 5). The eighth ventral abdominal segment in the female is prolonged posteriorly on the ventral side in an obtusely triangular flap nearly as wide as the abdomen.

This is the most abundantly represented species in the collection, and it is a typical *Perla*.

The eggs of this species as they appear when removed from the ovary are roundish oval with a revolute strongly chitinized collar at the micropylar end: the margins of the collar are lobed and fimbriate (pl. xix, figs. 6 and 7). The surface of the shell is pitted all over with little round shallow depressions.

Perla cymbele, sp. nov.

A single female specimen from Pharping, Nepal, altitude *circa* 5,000 feet (*R. Hodgart*, October 1907).

Very similar to the preceding species ; a little smaller. Length 12 mm. Expanse of wings 32 mm.

Brown. Head pale brownish, with a broad diffuse transverse band of darker brown between the eyes and covering the ocelli. Ocelli equidistant from each other and from the eyes, the anterior ocellus one-half smaller than the others. The elevated antero-lateral margins of the frons have a blackish tinge.

The prothorax is wider than the head. Its fore border is straight or slightly bisinuate, the anterior angles are slightly acute, the sides are slightly convex and convergent posteriorly to the slightly obtuse hind angles. There is a fine black transverse carina on the disc closely paralleling the front margin, joined in the rear by a similar mid-dorsal narrow black line. On the sides of the disc are some low obscure rugosities. The meso- and metathorax and the basal segments of the abdomen are yellowish brown. Legs yellowish brown, slightly darker on the tarsi. Wings smoky hyaline. Antennæ and setæ broken.

The posterior ventral prolongation of the eighth abdominal segment is slightly narrower than in *P. ione*, and distinctly bifid at the tip. It is thin and transparent, and not easy to see in dried specimens.

The eggs of this species are very different from those of *P. ione*, being elongate oval, or slightly narrowed to the micropylar end. They are deeply pitted all over the opposite end. The chitinised rim about the micropyle is low and smooth, and not revolute.

Neoperla indica, sp. nov.

Three males and five females. Kulu, W. Himalayas (Reg Nos. $\frac{6925}{1}$, $\frac{6950}{1}$, $\frac{6836}{1}$). A yellowish species near *Perla luteola*, Burm., and *Neoperla pilosella*, Klp., from Java. Length of male about 7 mm., expanse of wings 21 mm. Length of female about 10 mm., expanse 28 mm.

Colour brownish yellow, darker above on the head and prothorax, paler beneath and on all the appendages. Antennæ long, somewhat paler towards the base, and clothed throughout with close pubescence, as are the long yellow palpi. Head without distinguishable colour pattern, with a diffuse darker area on the disc and darker pigmentation around eyes and ocelli. Each of the two ocelli is separated from the other by about its own diameter.

Prothorax straight margined in front, slightly narrowed on the convex sides posteriorly in the male, but not perceptibly narrowed in the female, its disc sub-rugulose, and with a fine brown mid-dorsal line, and a similar line on each lateral margin. Legs yellow : only the claws brownish. Wings (pl. xx, fig. 1) yellowish, veins darker. Setæ and abdomen yellow, the former clothed with short pubescence.

The seventh abdominal segment of the male bears a mid-dorsal backwardly directed conical prominence with roughened tip, and the eighth segment bears a somewhat similar process that is, however, ante-apical, thin and flat and squarely truncated on the tip (pl. xx, fig. 2). The ninth segment is moderately produced on the lower side and upturned so as to cover a litt'e of the apex of the abdomen, and bears on its dorsal side a pair of roughened prominences, between which rest the tips of the longer prominences of the divided tenth segment. These latter are long-conic, directed forwards and convergent at tips.

The eighth segment of the female is apparently scarcely produced posteriorly on the ventral side, but straight margined, the thin edge of the sternite that covers the openings of the oviducts being very difficult to see.

Perla duvauceli, Pictet.

Hist. Nat. Névr., *Perlides*, pp. 258-9, pl. xxvii, figs. 1-2, 1841

Two males in the collection of the Museum from Kulu (Reg. Nos. $\frac{5840-41}{5}$). These specimens were pinned, and old, and badly shrivelled, but when boiled in KHO the essential characters became readily apparent. Both agree in size with Pictet's brief description, and one of them showed enough of colour pattern for comparison.

Length about 11 mm., with antennæ 5 mm. and setæ 3 mm. additional. Expanse of wings 25 mm. There are two minute ocelli wide apart upon the disc of the head: the antennæ and setæ are yellow, and pubescent, with hairs of the same tawny colour. The prothorax is narrower than the head, and is transversely oval in form, with all the angles rounded off, the hind angles a little more broadly rounded. The wings are yellowish, with weak venation, especially indistinct along the costal margin (pl. xix, fig. 11).

The ninth abdominal segment of the male (pl. xix, figs. 12—14) is very peculiar. Its posterior prolongation on the ventral side is short, not upturned around the end of the abdomen, and before it on the middle of the segment is a low, broad, hairy elevation bearing a membranous penis at its tip. The tenth segment is annular and exposed, one-third as long as the ninth; from its hind margin on the dorsal side there grows out posteriorly a short stout downwardly directed spine. To this spine are opposed two claw-like upcurved hooks that arise from the inner side of the base of the setæ.

I confess to much pleasure in identifying this species, which has stood for more than half a century as the only representative of this family known from India. It is destined ultimately to bear another generic name.

CRYPTOPERLA, gen. nov.

Eyes hairy; labial palpi greatly reduced; face vertical with high frontal ridge; venation as shown in pl. xix, fig. 15. Otherwise much like *Neoperla*.

Type, the following species:—

Cryptoperla tòrva, sp. nov.

(Pl. xix, figs. 15—21.)

A single female specimen from Kulu, W. Himalayas (Reg. No. $\frac{3848}{5}$).

Length 9 mm., and antennæ 7 mm. additional; setæ wanting.

Colour nearly uniform pale yellowish brown, a little paler beneath and on the setæ and bases of legs. Head very flat above, its disc margined anteriorly by an irregularly semicircular elevated margin, which overhangs the base of the antennæ, and beneath which the face is vertical. Ocelli apparently two but very obscure. Antenna with the obliquely conic second segment set at an angle upon the stout basal segment; there appears considerable irregularity in the slenderer segments immediately following; there are forty or more segments in all. Maxilla with palpus of normal length, but the labium with greatly abbreviated palpi having the terminal segment conically pointed (pl. xix, fig. 21).

The wings are subhyaline, slightly darker on the costal margin, especially in the stigmatic region: the venation is shown in pl. xix, fig. 15.

The eighth segment of the female is remarkably produced on its ventral side in an enormous scoop-shaped concave plate, widely truncated across the end, and covering the entire tip of the abdomen ventrally. Its lateral margins spring from the middle of the sides of segment 9 (pl. xix, fig. 1*a*).

Leuctra indica, sp. nov.

Three specimens from Upper Assam (Reg. Nos. $\frac{1321}{9}$, $\frac{1351}{9}$, $\frac{1348}{9}$).

Length of body 4 to 5 mm. and antennæ of equal length; expanse of wings of male 11 to 12 mm.

Colour brown, the legs, the under side of the body, the base of the antennæ and the middle of the abdomen, paler. Wings fumose with brown veins. Venation shown in figure 3 of pl. xx. The end segments of the abdomen are of a darker brown. The male appendages are shown in dorsal and lateral views in figures 4 and 5 of plate xx.

ODONATA.

The collection in this order consists almost entirely of well known representatives of the Indian fauna, and a list of it would add little to present knowledge. A single *Gomphidia T-nigrum* in the Lefroy collection is the only Gomphine in the lot. Apart from some of the smaller Agrioninæ, which I may take occasion to report on later, the most interesting specimens of the order were three species collected rather recently by Dr. Annandale. Two of these were from Bhim Tal, Kumaon; a fine pair of *Anotogaster basalis*,

Sél., and several of both sexes of the elegant *Megalestes major*, Sél., both collected on the 22nd of September 1906. The other one of the three is *Bayadera hyalina*, Sélys, represented by both sexes, from Kurseong, E. Himalayas, 5,000 ft.

EPHEMERIDÆ.

The mayflies of the collection were, as is always the case with pinned specimens, in rather dilapidated condition, and not all are determinable. There appear to be about nine species, as follows:—

Palingenia sp.? perhaps *P. robusta*, Etn.—In absence of figures of the male genitalia, I am unable to be sure about the identity of these specimens; all are in bad condition, more or less teneral, and with crumpled wings. The species will be recognized by the male forceps figured herewith (pl. xx, fig. 8), which is different from the forceps of any species that has been figured hitherto. It belongs to the subgenus *Anagenesia*. (The specimens are from Seistan, Persia —*N. A.*)

There are three nymphs of some species of *Palingenia* collected by Dr. Annandale at Matiana, Simla hills, and sent to me in alcohol.

Ephemera sp.—A series of specimens in the Lefroy collection from Pusa, Bengal, that at present I do not feel qualified to name; the forceps limb of the male is shown in pl. xx, fig. 9.

The genus *Epeorus* is represented by a fragment of a female sub-imago without locality label.

Chlœon marginata, Hagen.—This species and the following one, hitherto known only from Ceylon, are represented in the collection by a series of both pinned and alcoholic specimens. The specimens are from Calcutta, and from Rajshahi, E. Bengal, in February and December; from Sylhet in November and December; sub-imagos and cast sub-imaginal skins are included in the alcoholic material from Rajshahi, where the skins "were found on the walls of a room of a house some distance from water."

Chlœon bimaculatum, Etn.—This species was found with the preceding by Dr. Annandale at Rajshahi, E. Bengal. The wings of the male are quite hyaline, and therefore I think it is a female that is meant where male is stated in Eaton's *Monographic Revision of Ephemeridæ*; with that adjustment the agreement of these specimens with those described from Ceylon (p. 182), save for an unnoticed brown spot before the apex of the hind femur, appears to be complete. I figure on pl. xx, fig. 6, the wing of the female, and on pl. xx, fig. 10, the forceps limb of the male.

There are three small nymphs in alcohol which might belong, so far as I can see, to either one of the two preceding species.

Cænis perpusilla, Walk.—Specimens, both pinned and alcoholic from Rajshahi, appear to agree with this insufficiently known species, which was described from Ceylon. It may be

further described from material carefully preserved by Dr. Annandale, as follows:—

Length of male 3·5 mm., with setæ 11 mm. additional. Length of female about 4 mm., with setæ 3·5 to 4 mm. additional. Expanse of wings 9 mm.

White, with narrow lines of sooty black across the top of the head between the eyes, and on the sides of the prothorax, and on the humeri of the mesothorax and across the apex of the metathorax, and across the apical dorsal margins of the abdominal segments. The black is a little more pronounced towards the sides of the segments and towards the apex of the abdomen. Mesothorax pale brown above with a narrow paler median line. Wings whitish, with the usual purplish costal band, whose extent is indicated in pl. xx, fig. 7.

The nymphs of two additional species, also collected by Dr. Annandale, at Matiana, Simla district, W. Himalayas (8,000 ft.), are worthy of mention, since they are all that are known of two species representing other genera in India. The first of these is a single grown nymph (length 8 mm.) of a species of *Leptophlebia*, a genus hitherto unreported from India. The coloration is dark olivaceous above and yellowish below (perhaps greenish in life). The setæ are broken off. The side margins of the abdominal segments are narrowly yellow above, and there is a pair of small oblique submedian dots on the dorsum of each segment.

There are also two nymphs, of a species of *Heptagenia (s. lat.)*, from a small stream at Matiana, which differ from all known nymphs of that genus in the possession of a series of mid-dorsal abdominal hooks or triangular teeth, one terminating the mid-dorsal keel on each segment from the first to the ninth, successively smaller on the eighth and ninth segments. These are pale smooth nymphs, the larger of which measures 12 mm. in length of body. There is a conspicuous black spot on the humeral cross-vein in the nymphal wing which may be carried over in the adult.

PSOCIDÆ.

This family is represented in the collections before me by half a dozen species, three of which are well known, one of which is undeterminable, and the other two of which are new. Unfortunately, while the well-known species are represented by excellent series of specimens, the new ones are not, and are therefore left unnamed.

Psocus taprobenes, Hagen.—The Museum specimens of this handsome species are from Calcutta, Munshibazar (S. Sylhet) and Upper Assam, and those in the Lefroy collection are from Rungpore (Eastern Bengal and Assam), from Dacca, and from Pusa, Bengal.

Ceratipsocus subcostalis, Enderlein, is represented by a single specimen in the Museum collection from Upper Assam.

Myopsocus griseipennis, McL.—About a dozen specimens collected by Dr. Annandale at Bhim Tal, Kumaon (alt. 4,500 ft.), W. Himalayas, in September 1906.

Myopsocus sp. A.—A species very similar to the preceding, with an expanse of wing of 13 mm. and in coloration much less densely marmorate on the wings; stigma yellow, and basal cells of the wing and a space before the cubital vein more or less hyaline. Specimens from Upper Assam.

Ceratipsocus sp. B.—This is a smaller species (expanse of wings 8 mm.) with wings clouded rather than marmorate, and with an equal distribution of the clouds all over them: veins alternately white and black. Specimens from Upper Assam.

Epipsocus sp. (?).—Specimens in the Lefroy collection from Pusa, Bengal.

EMBIIDÆ.

I have spent much time over the three or four species of this family represented in the collection, with not very satisfactory results. I think I have identified *E. saundersi*, Westwood (from Surat, Bombay Presidency, "at light"; Pusa collection), and *E. michaeli*,[1] McLachlan, but what the third species that is represented by a single male specimen from Pamben, Rameswarem Island, Palk Straits, S. India, is, and whether described or not, I am unable to say. It is hard to pick out distinctive characters from bare descriptions. But my figures of the male abdominal appendages on pl xx, figs. 11—13, will enable anyone who comes after me to be certain as to what species I had before me. The third species, near *E. tartara*, Saussure, but with complete venation, 24-jointed antennæ, and an expanse of 17 mm., is perhaps the same as the large black wingless females in the Lefroy collection.

SIALIDÆ.

Corydalis territans, sp. nov.

One female from Sikkim, E. Himalayas (Reg. No. $\frac{8826}{3}$).

Length of body 40 mm. (probably considerably more in life for the abdomen is shrunken). Expanse of wings 136 mm. Head entirely rufous. Mandibles black. Antennæ broken, only two basal segments present; these are rufous at ends and broadly ringed with jet black between. The elevated rim of the vertex at the inner side of the antennæ is edged with black, as are the three close-set ocelli internally. Disc of the head rugulose, without colour pattern. The lateral margins of the hind angles of the head are thin and flat and minutely serrulate on their flaring border, produced behind into the usual sharp spine, and in this species ending anteriorly in a second thin flat triangular spine or tooth just behind the eye, while the tooth which in other Oriental species of this genus lies nearer the top of the head, is in this species wanting.

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[1] Males of this species are often found in Calcutta at night on whitewashed walls illuminated by lamps, both outside and in houses.—*N. A.*

Prothorax slightly longer than wide (length 7 mm., width 6 mm.), red and finely transversely rugulose above, with a long black lateral stripe each side, more or less tending to be broken into three spots. Second and third thoracic segments and abdomen of a sordid reddish fulvous.

Wings fumose, with partly hyaline cells between the brown-bordered costal cross-veins and with two conspicuous hyaline bars across the disc, bordered by areas of darker brown. These hyaline bars cross the area traversed by the radial, median and cubital veins; the proximal bar is at the level of the base of the radial sector and the second at the level of the first fork of the sector. On the proximal side of the first bar three basal cells are more or less hyaline, and on the distal side of the second bar are four small hyaline spots in the next adjacent cells, the two anterior quadrate, the two posterior smaller, linear, the three posterior, in line, and out of line with the first.

Hind wing without hyaline spots, with veins of darker brown all around the wing-margin.

Legs rufous beneath and basally, blackish superiorly and towards the apex. The fore femora are darker than the others.

The three Oriental species now made known in the genus, which was so long supposed to be strictly American, may be separated as follows:—

a. Two teeth on the lateral margin of the head, and none on the convex surface above the hind angle: head red .. *territans*, Ndm.

aa. One tooth on the lateral margin at the hind angle of the head on each side, and one above this on the convex surface. Head bicoloured.

b. The darkest markings of the fore wings comprised in a wide costal strip .. .. *asiatica*, Hardwicke, W. China.

bb. Darkest markings of the fore wings are upon the cross-veins of the wing disc .. *orientalis*, McL., Naga Hills, Assam.

There remains also a fourth species, mentioned by McLachlan in the *Transactions of the Entomological Society of London* for 1896, p. 283, but not described, from Assam, which agrees with *asiatica* and *orientalis* in the conformation of the hind angles of the head, and not at all with *territans*. Probably good specimens of this species will yet be found.

Of other Sialidæ, the collection includes four species of *Neuromus* and one of *Chauliodes*:—*Neuromus latratus* from Shillong, Khasi Hills, Assam; *N. infectus*, McL., from Sikkim; *N. decemmaculatus*,

Wlk., from the N. Khasi Hills (*Godwin-Austen*); and *N. maculipennis*, Gray, from the same locality. The *Chauliodes* is *Ch. simplex*, Walker, likewise from the N. Khasi Hills (*Godwin-Austen*).

MANTISPIDÆ.

All the members of this family that have hitherto been reported from India are represented in the Museum collection.

Mantispa nodosa, Westwood.—There is a single broken specimen of this huge species from the Domdami Valley, N. Assam (Reg. No. $\frac{9797}{15}$).

Mantispa rugicollis, Navas.—Of this species, recently described from the Himalayas, there is a single good specimen from Sikkim (Reg. No. $\frac{9798}{15}$). Another wingless fragment, apparently similar, is from Upper Assam (Reg. No. $\frac{1268}{9}$).

Mantispa quadrituberculata, Westwood.—There is a series of this handsome species from Kulu, W. Himalayas (Reg. Nos. $\frac{6921}{1}$, $\frac{6923}{1}$, $\frac{6924}{1}$), and Sibsagar, Assam (*S. E. Peal*).

Mantispa lineolata, Westwood.—From Kulu, W. Himalayas (Reg. Nos. $\frac{6916}{1}$, $\frac{6917}{1}$, $\frac{6919}{1}$).

Mantispa indica, Westwood.—Kangra Valley, W. Himalayas, 4,500 ft., November 1899 (*Dudgeon*); Sikkim; Upper Assam; Calcutta (Reg. No. $\frac{9799}{15}$).

PANORPIDÆ.

Four species representing this family are in the collection before me, two that have long been known, and two that are new to science.

Panorpa furcata, Hardwicke.—Soondrijal, Nepal (*Hodgart*, October, 1907) (Reg. No. $\frac{2785}{15}$), three females. There is also a single pale specimen that shows hardly more of coloration on the wings than the furcate middle band; I think it is a teneral specimen of the same species.

Panorpa appendiculata, Westwood.—This species is represented by four females in the Lefroy collection, from Igatpuri, Bombay.

Panorpa fenestrata, sp. nov.

(Pl. xxi, figs. 13—15.)

Upper Assam (Reg. Nos. $\frac{1273}{9}$, $\frac{1274}{9}$, $\frac{2094}{15}$).

Length of body 15 mm. Antennæ 11 mm. Rostrum 4 mm. Expanse of wings 28 mm.

Colour black, paler beneath and rufescent on the basal segment of the antennæ, on the hind angles of all the thoracic segments and on the sides of the rostrum. The last three abdominal segments of the male, wholly rufous.

Wings bicoloured, the basal half mainly hyaline, with two diffuse basal spots on the fore wings only, and just before the

middle with a broad transverse bar, broadly bifurcated in front, the arms of the fork surrounding a round hyaline spot on the costa. Apical half of the wings brown, inclosing a large transverse oval hyaline spot behind the stigma, and a smaller more proximal spot on the hind margin. The subcostal vein is confluent with the costal far before the stigma, and the upper division of the radial sector is three times forked. The abdominal appendages of the male are as shown in pl. xxi, figs. 13—15.

Panorpa sordida, sp. nov.

(Pl. xxi, figs. 16, 17.)

One male and two females, 64, 65 and 66, Pusa collection, from Khasi Hills, Assam (May) *c.* 5,000 ft., in wooded spots.

A pale brownish species with smoky hyaline, nearly concolorous wings.

Length, male 11 mm., female 10 mm. Antennæ of female 10 mm. Expanse of wings 22 mm.

Pale fuscous, the second and third thoracic segments fulvous, diffusely phalerate with blackish on all sutures. Base of antennæ tawny yellow. Legs of the same colour, the tips of the femora, tibiæ and tarsi brownish. Terminal segments of the abdomen in the male, tawny.

Wings smoky hyaline with brown veins, unmarked in the male and in one female, in the other female showing two brownish bands; the first a diffuse cross-band just beyond the middle of the wing, bifurcated and obsolescent behind, and an oblique apical spot beyond the stigma extending but little upon the hind margin beyond the apex. The sub-costal vein joins the costa at the level of the stigma, and the anterior division of the radial sector is twice forked. The abdominal appendages of the male are as shown in pl. xxi, figs. 16, 17.

NEMOPTERIDÆ.

Croce filipennis, West.—Specimens from Calcutta and from Katihar, Purneah District (*C. A. Paiva*); and in the Lefroy collection from Surat and Igatpuri, Bombay. [Common in Lower Bengal in March and April.—*N. A.*]

Croce capillaris, Klug.—Bushire, Persian Gulf (*W. D. Cumming*). One specimen.

Halter halterata, Forsk.—A series of specimens from N. Baluchistan (*Dr. Maynard*).

ASCALAPHIDÆ.

In the collections before me are all the Indian genera of this family save only *Ascalaphodes*, and also two new genera, described below. One of these is founded on the long-lost *Ascalaphus obscurus* of Westwood, while the other is represented by a new species.

HOLOPHTHALMI.

Idricerus decrepitus, Walk.—Two specimens, Dehra Dun, base of W. Himalayas, United Provinces, and the N.-E. Frontier of India (*Godwin-Austen*).

ABRONIUS, gen. nov.

Eyes undivided, body hairy, wings widest just before the middle, the front wings broader than the hind, and with a basal tooth that is penetrated by a branching vein: the area included in the cubital fork is wider than the area that lies in front of the cubital vein. The oblique vein that indicates the base of the hinder branch of the median vein is in the fore wing situated just before the base of the radial sector and just beyond the cubital fork. The

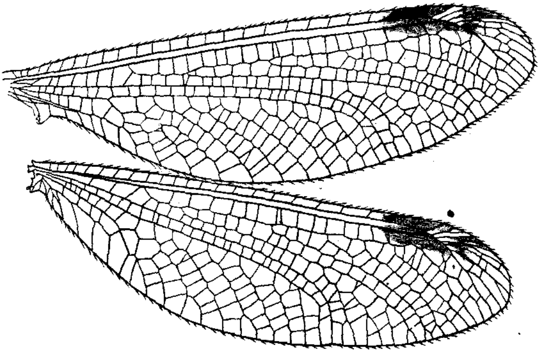


FIG. 1.—Wings of *Abronius canescens*, Ndm.

tibial spurs are as long as the three basal segments of the tarsus, the four basal segments are subequal and together hardly as long as the fifth, or as long as the claws.

Type, the following species:—

Abronius canescens, sp. nov.

A single incomplete specimen in the Indian Museum collection from Quetta, Baluchistan (*Webb-Ware*) (Reg. No. $\frac{2327}{4}$).

Expanse of wings 54 mm. A pale greyish and tawny species with hoary vestiture. Face yellow, clothed with brown-tipped hairs, and with a tuft of longer whitish hairs arising between the bases of the antennæ. Behind the head several erect fringes of stiff hairs arise in transverse lines from the front of the thorax. Wings

hyaline with brown cross-veins, stigma yellow, diffuse, but conspicuous. Fore and hind wings of nearly equal length, but the hind wing somewhat narrower. In the cubito-anal loop of the fore wings there is but one cross-vein beyond the level of the cubital fork. Legs yellow, with hoary hairs intermixed with slender black spines. Abdomen wanting.

I judge from the description that the (?) *Idricerus albardanus* of McLachlan from Mesopotamia, belongs also to this genus.

SCHIZOPHTHALMI.

Ogcogaster segmentator, West.—Seven specimens, males and females, in the Museum collection from Kulu, W. Himalayas (Reg. Nos. $\frac{6807}{1}$, $\frac{6880}{1}$, $\frac{6881}{1}$, $\frac{6886}{1}$, $\frac{6887}{1}$, $\frac{6889}{1}$, $\frac{6811}{1}$), and one from Mundi, W. Himalayas (Reg. No. $\frac{9635}{2}$).

Ogcogaster tesselatus, West.—One specimen in the Lefroy collection from Rawalpindi, Punjab, and one from Sirsiah, Bengal.

Acheron longus, Walk.—A number of specimens, mostly females, from Upper Assam; Sibsagar, Assam (male); Arrakan and Tavoy, Burma. [Also two specimens from Buxa, Bhutan frontier, E. Bengal, determined by de Sélys.—*N. A.*]

Hybris angulatus, West.—Several specimens (I cannot be quite sure about the females, which are still best determined by association with their males) from Johore, Malay Peninsula (*J. Wood-Mason*); Tavoy, Lower Burma (Reg. No. $\frac{8189}{7}$); Sibsagar, Assam (*S. E. Peal*); and Calcutta.

Hybris javanus, Burm.—Two males, both broken specimens, from Karachi, W. India (*Cumming*).

Glyptobasis dentifer, West.—One male, Dehra Dun, base of W. Himalayas, October 14th (Reg. No. $\frac{3018}{14}$).

Siphlocerus nimius, Walk.—One broken female specimen from Pusa, Bengal (*Lefroy collection*).

Helicomitus sp.?—A number of specimens, all females and therefore undeterminable (with our present knowledge of this genus), from Barsoë, Purneah District, N. Bengal, and from Calcutta, in the Museum collection; and from Pusa and Mohanpore, Bengal, in the Lefroy collection.

STYLONOTUS, gen. nov.

Superior and inferior divisions of the eyes subequal. Club of antennæ short, obconic. Wings narrow, with their front and hind margins parallel for most of their length, fore wings much longer than the hind, meshwork open. Hind angle of the fore wing without tooth or conspicuous angulation, the radial sector five or six times forked, the median vein apparently simple, there being no oblique vein to indicate the base of a posterior branch; stigma conspicuous. The third segment of the abdomen bears a conspicuous dorsal process, longer than the segment.

Type, *S. Ascalaphus obscurus*, West.

Stylonotus obscurus, Westw.

McLachlan refers to this (*Trans. Ent. Soc. London* for 1891, p. 513) as a lost species. It is represented in the collection before me by one male and four female specimens. Evidently Westwood knew only the female, for he could not have missed describing the extraordinary process that arises from the back of the male abdomen. The females agree well with his description, not all of them, however, showing clearly the velvety black lines on sides of the basal abdominal segments; but some of them show these lines finely. The male may be described as follows:—

Length 26 mm. Antennæ 16 mm. Expanse of wings 55 mm. Length of fore wing 23 mm., of hind wing 19 mm. Brownish,

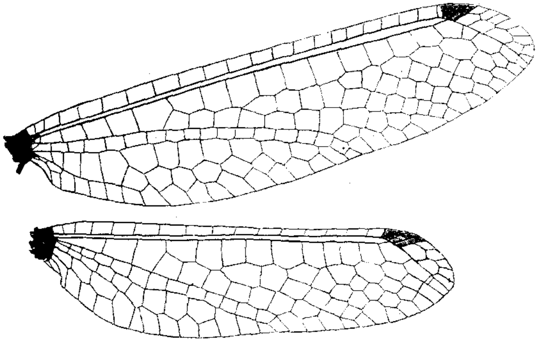


FIG. 2.—Wings of *Stylonotus obscurus*, Westw.

more or less hairy about the face, the sides of the thorax and the base and apex of the abdomen a vertical line of shining yellowish brown on the cheeks next the eyes; vertex tipped with long erect yellowish hairs. Rear of head smooth, shining, black on its lower half, yellow on the upper, with a transverse black line each side traversing the yellow area. Legs yellowish. Wings hyaline with clear reddish-brown veins and a reddish stigma that covers about four cells. Abdomen brown, paler at base, where encircled with long whitish hairs; the third segment bears a long apical stylus twice as long as the segment, clothed beneath its obtuse tip with short dense black pubescence. Terminal abdominal appendages short and concealed by the apical hairs. The single male specimen is from Kulu, W. Himalayas (Reg. No. $\frac{6854}{1}$). There are two females from the same locality and two from Mundi, Kangra district, W. Himalayas (3,200 ft.) (Reg. Nos. $\frac{2636}{2}$, $\frac{2638}{2}$).

MYRMELEONIDÆ.

The Myrmeleonidæ of the collection sent me are a most showy and interesting lot; among them are represented a considerable proportion of the described regional forms. The list is as follows:—

Stiphroneura inclusa, Walk.—Sikkim, E. Himalayas. One specimen.

[There is also a specimen in the collection from Upper Burma.—*N. A.*]

Stenares improbus, Walk.—Bangalore, S. India (*Cameron*). One specimen.

Palpares tigroides, Walk.—Dalkhola, Purneah District, N. Bengal (*C. A. Paiva*). One specimen.

Palpares contrarius, Walk.—One in the Lefroy collection from Mussoorie, United Provinces, and one in the Museum collection from Khurda, Orissa, 23-iii-84 (*W. C. Taylor*) (Reg. No. $\frac{4182}{10}$).

Palpares infimus, Fabr.—One specimen in the Lefroy collection from Bulsar, Bombay Presidency.

Palpares pardus, Rbr.—A number of specimens of this handsome and very variable species in the collection of the Museum from Dehra Dun, base of W. Himalayas, October 1900, from Khurda, Orissa (*W. C. Taylor*), and from Bangalore, S. India (*Cameron*) [also from Rampur Haut, Bengal, "common in railway carriages at light," 10-x-1907 (*Paiva*).—*N. A.*], and in the Lefroy collection from Surat, Bombay, and from Pusa, Bengal.

Palpares sp. ?—Perhaps a variety of the preceding, in the Lefroy collection, from Pusa, Bengal.

Periclystus singularis, West.—Two specimens in the Lefroy collection, one from Surat, Bombay, the other from Pusa, Bengal.

Tomatares compositus, Walk.—One fragment in the Museum collection from Cutch, W. India.

Acanthaclisis edax, Walk.—One specimen from Ramnad, Madura district, S. India; Aug., 1905 (*Annandale*) (Reg. No. $\frac{9423}{14}$).

Acanthaclisis horridus, Walk.—One specimen from Sibsagar, Assam.

Acanthaclisis eustalacta, Gerst.—One specimen from Lucknow, United Provinces (*B. Aitkin*).

Myrmeleon marginicollis, Gerst.—Several specimens from Kulu, W. Himalayas.

Myrmeleon sagax, Walk.—Several specimens from Bhim Tal, Kumaon, W. Himalayas, and Upper Assam. [Also three specimens from Kurseong, E. Himalayas.—*N. A.*]

Myrmeleon punctulatus (?), Rbr.—One specimen from Chatrapur, Ganjam district, Madras.

Formicaleo verendus, Walk.—Several specimens in the Museum collection from Kulu and one from the Kangra Valley, W. Himalayas; one in the Lefroy collection from Mussoorie, United Provinces.

Formicaleo periculosus, Walk.—A number of specimens in the Lefroy collection from Pusa, Bengal.

Macronemurus nefandus, Walk.—Three specimens in the Museum collection; two from Kulu, W. Himalayas, and one from Dehra Dun, base of W. Himalayas.

Macronemurus infestus, Walk.—One specimen in the Lefroy collection from Surat, Bombay, and one from Pusa, Bengal.

Creagris sedulus, Walk.—One specimen in the Lefroy collection from Mussoorie, United Provinces, and one from Palamow, Bengal, three in the Museum collection from Chatrapur, Ganjam district, Madras, and one from Shahzadpur, Allahabad, United Provinces.

Myrmeleon adversus, Walk.—Two specimens of what I take to be this species are in the Lefroy collection, one from Pusa, Bengal, and one from Bulsar, Bombay Presidency.

Myrmecalurus acerbus, Walk.—A number of specimens in the Museum collection from Bushire, Persian Gulf (*W. D. Cumming*); Baluchistan (*J. Cleghorn*); Seistan, Persia (*Sir A. H. McMahon*), and in the Lefroy collection from Mussoorie, W. Himalayas, United Provinces; Palamow, Bengal; Chevist, Punjab; and Pusa, Bengal.

CHRYSOPIDÆ.

This family is represented in the collections before me by at least a dozen species representing five genera, one of which is a new genus. Apparently but two species, *Chrysopa ignobilis*, Walk., and *Ancylopteryx candidus*, Fabr., stand in our lists to the credit of India. Nevertheless there are numerous described Oriental species in several genera, and some of them are poorly described. Therefore, I have refrained from describing any but the most strongly marked species in the collections sent for study, especially those belonging to the enormous genus *Chrysopa*.

Besides the new genus *Tumeochrysa* described below, the recently described *Eremochrysa* of Banks, hitherto known only from America, is represented in the collection by a single handsome species.

The genera of Chrysopidæ of the Indo-Australian region may be separated as follows:—

a. Cells in the basal part of the fork of the median vein alike, the third ("third cubital cell") undivided; antennæ excessively long and slender, much longer than the fore wings; the three series of gradate veins of the fore wing not parallel.

b. The first (innermost) series of gradate veins joins the radial sector anteriorly;

cells of the wing disc broad and venation open, net-like .. *Synthochrysa*, gen. nov. Type *H. stigma*, Girard.

bb. The first series of gradate veins parallels the radial sector for much of its length and anteriorly joins the second series; all cells of the wing disc and outer margins are narrowly transversely linear .. .. *Apochrysa*.

aa. Of the cells in the basal part of the main fork of the median vein the third is differentiated, appearing to be transversely or obliquely divided.

b. Apparently about equally divided .. .. *Nothochrysa*.

bb. Very unequally and obliquely divided.

c. Gradate veins distributed irregularly over the wing disc, not in regular series. Basal segment of the antennæ enormously enlarged .. *Tumeochrysa*.

cc. Cross-veins of the fore wing forming two rather regular gradate series.

d. Basal part of the costal space narrow, gradually widened towards the middle of the wing.

e. With a single gradate series in the hind wing .. .. *Eremochrysa*.

ee. With two gradate series in the hind wing .. .. *Chrysopa*.

dd. Costal space of the fore wing suddenly and greatly dilated *Ancylopteryx*.

Nothochrysa robusta, sp. nov.

A single female specimen (the type) from Sibsagar, Assam (*S. E. Peal*) (Reg. No. $\frac{8822}{15}$), and a single male that I take to belong to the same species, from Darrang, western base of Dafla Hills, also in Assam (*Godwin-Austen*).

Length of female 19 mm. Antennæ 16 mm. additional. Expanse of wings 62 mm.

Colour tawny yellow, including the legs; the top of the thorax and the eyes with coppery reflections. Antennæ brownish, paler

basally. Prothorax wider than long, with the front angles broadly eroded, and the hind angles square, front and hind borders darker in colour and with a sulcate middle brown median groove.

The male is slightly smaller and the prothorax is as long as wide, and on either side of its disc are four oblique brownish dashes arranged in two pairs.

The wings of both male and female are hyaline with veins mostly yellow. The ends of all cross-veins abutting on the radial vein are blackish, this colour more intense apically, where the apex of the radial sector also is black. Gradate cross-veins black, and in the inner series the connecting veins also. There are sixteen cross-veins in the inner gradate series. The wing roots are strongly stained with brown, including also a few stout basal cross-veins.

Nothochrysa lefroyi, sp. nov.

A number of specimens of both sexes represented in both collections. In the Lefroy collection from Pusa, Bengal; Lyallpur, Punjab; and from the Khasi Hills, Assam (3,000—5,000 ft.). The Museum specimens are from Kulu, W. Himalayas, and Sibsagar, Assam (*S. E. Peal*) (Reg. Nos. $\frac{6324}{1}$ and $\frac{5878}{8}$).

Length of body 11 mm. Antennæ 14 mm. additional. Expanse of wings 38 mm.; fore wing length 18 mm., width 5 mm.; hind wing length 17 mm., width 4·5 mm.

Colour dull fulvous, with phalerate sutural markings of greenish black. Face tawny yellow, with reddish brown lines on the sutures. Antennæ black except at the base where two segments are more or less yellowish. Eyes with coppery and greenish bronze reflections. Prothorax with eroded front angles (as in the preceding species) about as wide as long (a little wider in the female), with a narrow mid-dorsal longitudinal sulcus, dull tawny yellowish in colour, with darker, diffuse triangular spots extending upwards from the sides in some of the (female) specimens. Meso- and metathorax tawny yellow, phalerate with greenish black on the sutures. Legs yellowish, hind ones paler. Wings hyaline, veins tawny yellow, no black on cross-veins. Stigma diffuse, rather long. Nine gradate cross-veins in the inner series.

Nothochrysa indigena, sp. nov.

Two specimens from Calcutta in the Museum collection, one labelled "Indian Museum premises (*R. Hodgart*)."

Length of body 13 mm. Antennæ 15 mm. Expanse of wings 38—42 mm. Fore wing of the type specimen (Reg. No. $\frac{9585}{7}$), length 18 mm., width 7 mm.; hind wing, length 17 mm., width 5·5 mm.

A yellowish fulvous species with a black dorsal band covering the second and third segments of the thorax and the fourth, fifth, and sixth segments of the abdomen, and with large and conspicuous brown stigma. Head fulvous, including the antennæ. Eyes with

coppery reflections. Wings hyaline, veins yellow. Wing-roots black, as are two cross-veins in the anal angle. The gradate cross-veins are also blackish, and a few of the cross-veins joining the radial vein and the radial sector are blackish on both their ends. Inner gradate series consists of eight or nine cross-veins.

TUMEOCHRYSA, gen. nov.

Allied to *Anomalochrysa* of the Hawaiian Islands, having the cross-veins of the wing disc scattered, not arranged in regular gradate series. Antennæ about as long as the body, shorter than the wings, in the male at least with huge erect tumid basal segments.

Type *T. indica*.

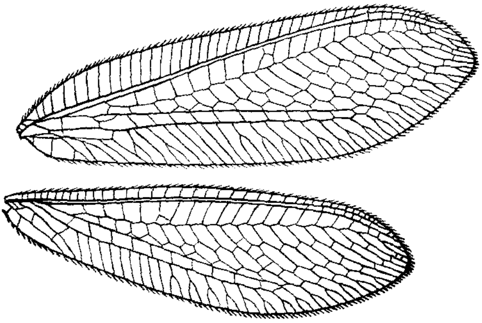


FIG. 3.—Wings of *Tumeochrysa indica*, Ndm.

Tumeochrysa indica, sp. nov.

One male specimen collected by Dr. Annandale at Bhim Tal, Kumaon, W. Himalayas (4,500 ft.), 19—22-ix-06 (Reg. No. $\frac{9841}{18}$).

Length 15 mm. Antennæ 15 mm. Expanse of wings 45 mm.

A rather slender and elongate species, yellowish in colour (perhaps greenish in life). Face yellow. Head surmounted by the high, erect, basal antennal segments, which nearly cover its entire width, and which are closely approximated to one another. Each basal segment is yellow, swollen, sub-tuberculate on the postero-internal side, and is as long as the next twelve subequal segments succeeding it, and bears on its outer side a diffuse red line. On the disc of the head there is in the rear a similar transverse red line from eye to eye, extended forward between the basal segments of the antennæ on the median line in a diffuse triangular dilatation.

Thorax yellow beneath, somewhat darker above and tinged with reddish on the principal convex areas. Legs pale yellow, the tips of the tarsi darker. Wings hyaline with yellow veins, otherwise unmarked. Abdomen yellow beneath, somewhat darker above, and clothed with scanty yellowish pubescence. The paired lateral appendages short and scarcely forcipate. There is a median ventral appendage, three times as long as the laterals, jointed at two-thirds its length, and with the tip strongly reflexed at this joint.

Eremochrysa marmorata, sp. nov.

A single specimen from Upper Assam in the Museum collection (Reg. No. $\frac{2096}{10}$), broken and incomplete, but striking and characteristic. I refer it tentatively to *Eremochrysa* of Banks, and with it McLachlan's New Zealand species *Chrysopa opposita*.

Length of body about 10 mm., of antennæ about 12 mm. Expanse of wings 25 mm. The coloration is wholly obscure save in the wings, which are beautifully marked, and are quite sufficient for the recognition of the species. The membrane of the wings is hyaline, and the cross-veins are all tinged with golden brown, strongly on the basal third of both wings, and all about the entire wing margins, weakly and diffusely and confluently over the wing disc. The brown on the base of the radial sector and about the stigma amounts to diffuse spots of distinctly darker colour.

Ancylopteryx tesselatus, sp. nov.

Four specimens in the Museum collection, two from Upper Assam (Reg. Nos. $\frac{1275}{9}$ and $\frac{1278}{9}$) and two from Sibsagar, Assam (*S. E. Peal*) (Reg. No. $\frac{9823}{15}$).

Length to wing tips 15 mm., expanse of wings 28 mm. Antennæ about as long as the fore wings. Head, including antennæ, and prothorax pale yellow. Prothorax one half longer than wide, legs yellow, the tips of the tarsi somewhat darker. Wings hyaline and veins white. There are pale cloud-like brown spots at the stigma, at the hinder end of the inner gradate series of cross-veins and on the tips of the cubital vein where these reach the hind margin. And there are paler more diaphanous and more confluent clouds on three or four of the cross-veins at the rear of the stigma (at the front of the radial vein), on the base of the radial sector and on the anterior gradates, and in alternate spaces along the hind margin of the fore wing. Hind wing similarly marked, but less distinctly, only the basal spot being at all clear.

Ancylopteryx candidus, Fabr.—One specimen from Upper Assam (Reg. No. $\frac{1316}{9}$).

HEMEROBIIDÆ.

Two indigenous genera, *Hyposmylus* and *Berotha*, and two wide-spread ones, *Hemerobius* and *Drepanopteryx*, are not represented in the collection; the genus *Osmylus* is represented by two of

its five species: *Sisyra* is represented by bred specimens of the new species discovered by Dr. Annandale in the freshwater sponges, *Spongilla carteri* and *S. alba*, and whose habits are briefly described by him in a paper on "Some animals found associated with *Spongilla carteri* in Calcutta" (*Journ. Asiatic Soc. Bengal* (N.S.), 2, pp. 187—196, 1906). And in addition to this new *Sisyra*, there are two new genera of Hemerobiidæ represented.

I think I have identified the *Hemerobius setulosus* of Walker, and it is a *Micromus*.[1] And since McLachlan long ago identified Walker's *Hemerobius setulosus* as a species of *Osmylus*, the typical genus *Hemerobius* appears to be without a representative in India. A second species of *Micromus* is represented by a poor teneral specimen in the Lefroy collection, which agrees in size and number of divisions of radial sector, and number of cross-veins in its gradate series with *M. australis*, Hagen, from Ceylon, and it is probably that species; colour comparison is impossible.

The two species of *Osmylus* in the collection are *O. langi*, McL., from Kulu, W. Himalayas, and Kurseong, E. Himalayas; and *O. tuberculatus*, Walker, from Upper Assam and from the valley of the Tenasserim river, Lower Burma.

The new species and genera are described below.

Sisyra indica, sp. nov.

(Pl. xxi, fig. 1.)

Male and female specimens, bred by Dr. Annandale from larvæ taken on *Spongilla carteri*. Bred 16th March, 1907. [Common in Calcutta.—*N. A.*]

Length to wing tips 5 mm. Expanse of wings 10 mm. Length of antennæ 3 mm. Colour brown, nearly uniform. Antennæ black. Legs pale. Disc of head and thorax clothed with sparse yellowish hairs. Prothorax wider than long. Abdomen blackish, except the apex which is somewhat paler. Wings (pl. xxi, fig. 1) smoky hyaline, with brown veins. Costal cross-veins very unequally distributed, there being about ten in the basal half and only one in the distal half of the space between the base and the stigma.

The median vein is three times dichotomously forked in the fore wing, but in the hind wing the posterior division of this vein has one forking fewer than the anterior. The ovipositor of the female is straight and stout and blunt at tip, and is about as long as the abdomen is thick. The paired lateral appendages of the abdomen in the male are stout and convex and hairy basally on the outer side, but internally they are suddenly extended in a pair of long slender claw-like processes directed inwards and crossed at their tips, these slender horny processes being longer than the basal part from which they arise.

The cocoon of this species is oval in form and 4 mm. long. It consists of fine spun pure white silk, close woven; the outer

[1] The specimen is from Kulu, W. Himalayas.—*N. A.*

layer is irregularly woven, with stay threads extending to all the high places in the dried sponge mass, in the hollow of which it nestles.

The larva of this species is 4·5 mm. in length, and 1 mm. in width, and its suctorial setæ are as long as the head and thorax together and somewhat longer than the setaceous antennæ. The setæ on the middle abdominal segments are rather more closely sessile than in the other larvæ of *Sisyra* hitherto described, but otherwise apparently similar. Some of the larvæ sent me by Dr. Annandale were taken by him from osteoles of *Spongilla alba*.

Dr. Annandale has sent me the following notes on the habits and ethology of this species:—

"I am now able to send you larva, pupa and adult of the common sponge *Sisyra* of Calcutta. This species is common in the canals of *Spongilla carteri*, one of our most abundant freshwater sponges in India. I have only found the larvæ between August and March, that is to say in the rains and cold weather, but the sponge as a rule dies in the hot weather. The larvæ vary from green to white in colour, and can usually be discovered clinging to the walls of the oscula and larger canals of the sponge, in which these strnctures are more patent than they are in most Indian species. The proboscis seems to be inserted into the substance of the cells of the host, and if the sponge is green, the contents of the stomach of the parasite are also green. If the sponge dies, and the water becomes foul, the parasite forsakes it; and I have even found a few individuals among filamentous algæ in the tanks. The mode of progression adopted, when the insect is at large, is either that of crawling slowly on a solid support or that of swimming through the water by means of movements of the abdomen. The thorax is held vertically upright, in the latter case, with the head flexed a little downwards and the abdomen strongly upward; so that the whole animal has the outline of an S when seen from the side. The abdomen is alternately approximated to and removed from the thorax with great rapidity, and these actions bring about a forward movement. I could not observe any regular movements on the part of the jointed gills, but apparently they aid in supporting the insect upright in the water.

"At the beginning of March a great number of specimens of *Spongilla carteri*, being attached to the ends of hanging branches and in similar situations, are left high and dry, as the water evaporates from the tanks. In the circumstances the larvæ, sooner or later, leave the interior of the sponge, in which they sometimes continue to live for some days after it has been left dry, and pupate in hollows on the external surface. A flimsy cocoon of white silk, covered and fixed by a loose web of the same material, is spun, and the imago emerges in about a week. The imago is very sluggish and apparently takes to flight with difficulty."

ANNANDALIA, gen. nov.

Mandibles strongly dentate. Palpi with the terminal segment lanceolate, attenuate to apex. Antennæ short. Wings short and broad, hairy. Subcosta and radius separate to the wing margin. Costal space wide basally, with a basal recurrent vein. Two subcosto-radial cross-veins, one basal and one near the middle of the wing. One series of gradate veins in the fore wing situate just beyond the middle of the wing, wanting in the hind wing, both wings with a very wide area of dichotomous forks.

Type, the following species :—

Annandalia curta, sp. nov.

(Pl. xxi, figs. 2—4.)

Two specimens from Calcutta, collected by Dr. Annandale on the 3rd August, 1906. [Single individuals of this species are not uncommonly found in Calcutta seated at night round lamps on the whitewashed walls of houses. They are very sluggish. —*N. A.*]

Length of body 4 mm. Length to wing tips 5 mm. Antennæ 2 mm. Expanse of wings 9 mm. Fore wings, length 4 mm., width 2 mm.; hind wings, length 3 mm., width 1·5 mm. Fore wings oblong, obtusely rounded at both ends, and oblique; hind wings obovate obtuse at outer end. Membrane of wings hyaline, strongly marked with brown in two shades, the colour being laid on in transverse concentric lines around the wing base as a centre. The veins are alternately yellow and brown, the brown occurring where the concentric lines of dark colour cross the veins. There are three darker areas in the fore wing, a blackish one on the base of the wing extending outwards to the base of the radial sector, upon which is a black tri-radiate spot; there is a second dark area, a little paler, laid across the base of the second division of the radial sector, and this is confluent at fore and hind margins of the wing with a third darker area, which encircles the wing apex covering the terminal forks of the veins. The hind wings are largely hyaline, slightly infuscated on the costal area and on area of the marginal forks. The hind wing is almost without cross-veins. The anterior branch of the cubital vein is in the fore wing dichotomously four times forked, and the median vein three times forked.

The general colour of the body is blackish brown. The head is wholly blackish The antennæ are dull yellowish, darker at both ends. The antennæ consist of about forty remarkably uniform segments, each hardly longer than wide, only the two basal and terminal segments markedly differentiated; the basal one being four times as long as the second segment, and likewise the last segment about twice as long as the others. The labrum is semicircular, and the palpi are black in colour and lance-acumiate in form.

PAROSMYLUS, gen. nov.

Labrum emarginate, mandibles broad and coarsely toothed. Fore coxæ (in the male at least) with a cylindric corneus internal process. Wings broad, moderately hairy, costal area narrow at base, widened beyond, and traversed by numerous partly branched cross-veins; subcosta and radius fused at tip. One basal subcostal cross-vein, the radial sector arising near it.

Gradate cross-veins hardly differentiated, the cross-veins of the disc being numerous and irregular in arrangement. Median and cubital veins each with two long closely parallel branches, suddenly terminating in the peripheral border of marginal forks, the hinder branch of the cubitus with a long dependent series of forks to the hind margin. Tarsal claws serrate basally.

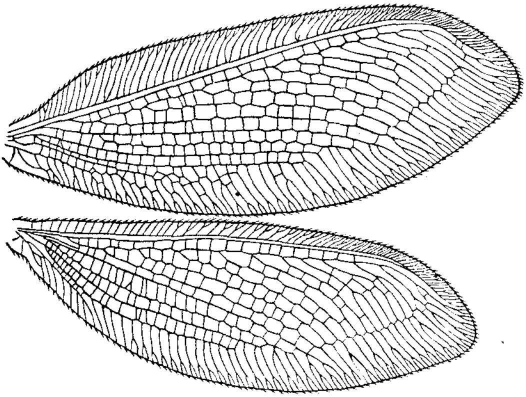


FIG. 4.—Wings of *Parosmylus prominens*, Ndm.

Type, the following species:--

Parosmylus prominens, sp. nov.

(Pl. xxi, figs. 5—10.)

Four specimens, male and female, from Kulu, W. Himalayas, and one from Lahoul (10,400 ft.), W. Himalayas.

Length of body 14 mm. Antennæ 10 mm. Length of fore wing 27 mm., of hind wing 26 mm.; expanse of wing 57 mm.

Colour fuscous, paler beneath and on sutures. Head with a broad convex prominence just behind the three ocelli. Antennæ short, consisting of about 56 segments, with a short stout cylindric basal segment and the third segment about twice as

long as the second or the fourth. Palpi short, their segments of nearly equal length. Legs rather stout and long; fore coxæ with the internal process shown in plate xxi, fig. 5, and all the claws basally serrate (plate xxi, fig. 9).

The wings are broad except at base, with membrane smoky hyaline and parti-colonred brownish veins. The wide costal strip is traversed by long close-set cross-veins separating between very narrow cells; and when forked, the forks are short and close to the costa. The cells of the disc are more or less hexagonal or quadrate but towards the region of the terminal forks they become very much elongated. The first forks of the radial sector and of the median vein are at about the same distance outwards from the wing base, and the sector closely parallels the main stem of the radial vein. The colour pattern of the wings is very complex, the dull brown touches being minute. There is a series of alternate lighter and darker brownish touches about the whole wing margin; four or five of these are decurrent from the front margin and traverse the yellowish stigma. There is a series of minute brownish clouds covering the cross-veins between the radius and its sector, there are three larger ones laid across the branches of the cubital vein, and there are numerous faint clouds upon the disc and on the anal angle. There is a round, more or less tuberculoid spot in the middle of the disc, fainter in the hind wing. The hind wing as a whole is paler, the disc being almost hyaline.

The genital apparatus of the male is most curious and puzzling It is shown in lateral view in plate xxi, fig. 8. What I have been tentatively calling a sperm conveyor depends from the hindmost segment. This is boat-shaped in outline, with a pair of minute palps on the bi-lobed posterior end. It appears to be capable of being swung in and out on a more or less flexible and muscular pedicel, and when swung inwards, its point must be close to the sperm orifice. The abbreviation of the segment before it, and the prolongation of the one before that, are shown in the figure; and behind the ventral prolongation of the apex of the last mentioned segment protrude a pair of lanceolate processes of uncertain function. Observation of living specimens would be most valuable, as an aid to understanding these parts.

There is a fragment of a second species from the valley of the Tenasserim river (Reg. No. $\frac{6008}{4}$) with the male genitalia well preserved. It is obviously different (pl. xxi, figs. 11 and 12).

EXPLANATION OF PLATE XIX.

FIG. 1.—Wings of *Perla benigna*, Ndm.

,, 2.—End of male abdomen of same, dorsal view.

,, 3.—The same in lateral view.

,, 4.—Base of seta and recurved appendage of its base, as viewed from within.

,, 5.—End of male abdomen of *Perla ione*, Ndm., in lateral view.

,, 6, 7.—Outlines of eggs of same.

,, 8.—The ventral aspect of the eighth and ninth segments of the female of the same species.

,, 9.—Like view of the same parts in *Perla cymbele*, Ndm.

,, 10.—The egg of *Perla cymbele*, Ndm.

,, 11.—Wings of *Perla duvaucelii*, Pict., male.

,, 12—14.—Dorsal, ventral and lateral views, respectively, of the tip of the abdomen of the male in the same species.

,, 15.—Wings of *Cryptoperla torva*, Ndm.

,, 16.—Foot of same.

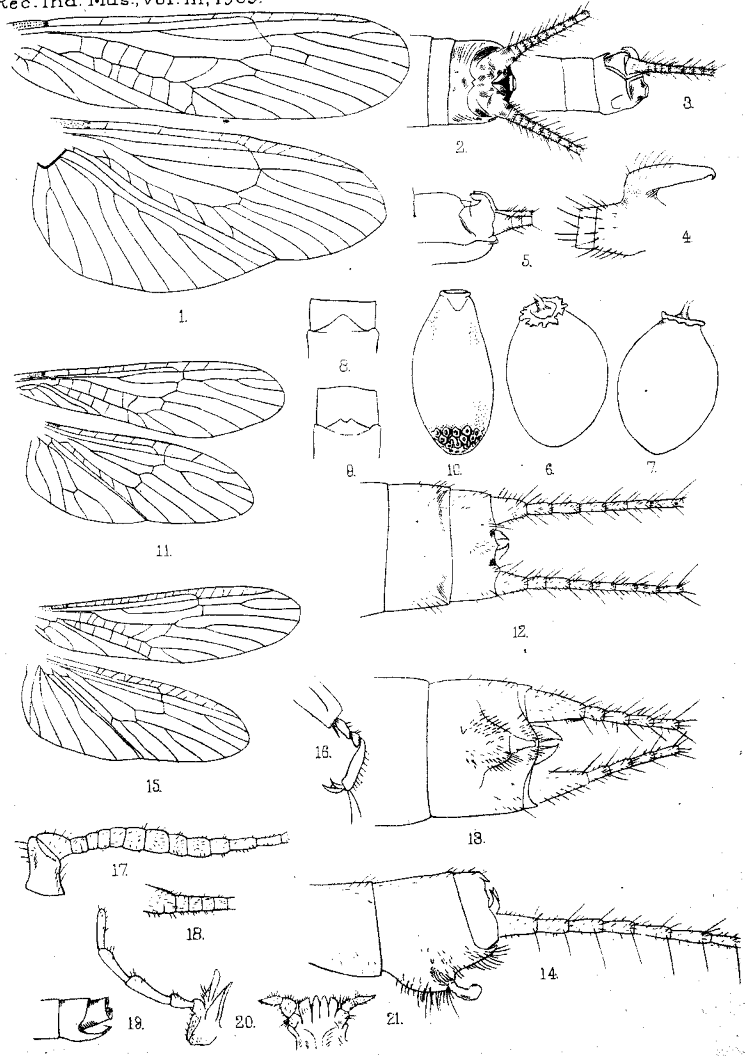
,, 17.—Base of antenna of same.

,, 18.—Base of abdominal seta of same.

,, 19.—Lateral view of the seventh, eighth and ninth abdominal segments of the female of the same species, showing enormous lamina.

,, 20.—Maxilla of the same.

,, 21.—Labium of the same, showing reduced palpi.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EXPLANATION OF PLATE XX.

FIG. 1.—Wings of *Neoperla indica*, Ndm.

,, 2.—Dorsal view of end of male abdomen of same.

,, 3.—Wings of *Leuctra indica*, Ndm.

,, 4, 5.—Dorsal and lateral views, respectively, of the end of the male abdomen of the same.

,, 6.—The wing of *Chlœon bimaculatum*, Etn.

,, 7.—The wing of *Cænis perpusilla*, Walk.

,, 8.—Genital appendages of the male abdomen of *Palingenia* sp. (?).

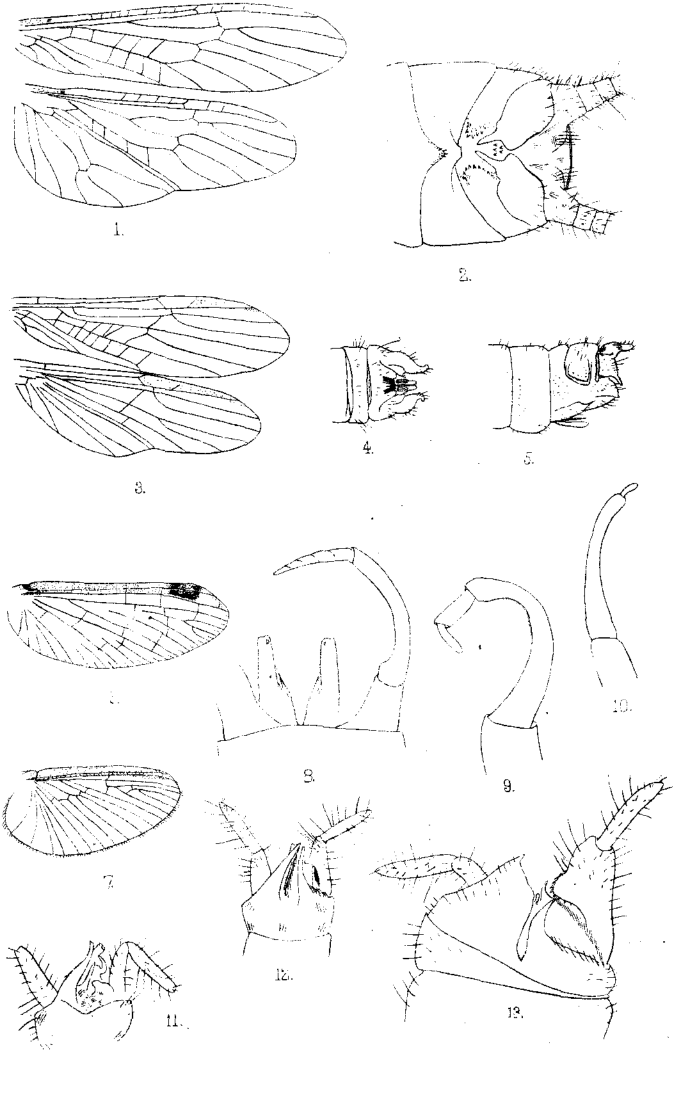
,, 9.—Forceps limb of the male of *Ephemera* sp. (?).

,, 10.—Forceps limb of *Chlœon bimaculatum*, Etn.

,, 11.—Dorsal view of the tip of the male abdomen of *Embia saundersi*, West.

,, 12.—The same view of like part in *Embia michaeli*, McL.

,, 13.—The same view of like part in *Embia* sp. (?).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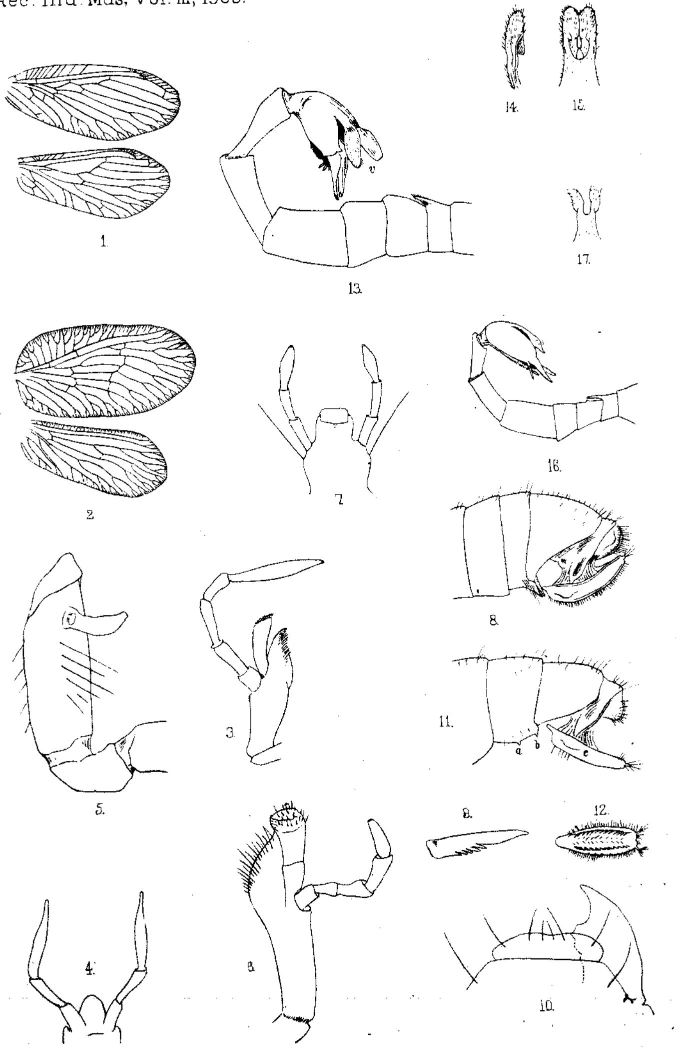
EXPLANATION OF PLATE XXI.

FIG. 1.—Wings of *Sisyra indica*, Ndm.
,, 2.—Wings of *Annandalia curta*, Ndm.
,, 3.—Maxilla of the same.
,, 4.—Labium of the same.
,, 5.—Base of fore leg of *Parosmylus prominens*, Ndm. (male).
,, 6.—Maxilla of same.
,, 7.—Labium of same.
,, 8.—End of male abdomen, in lateral view.
,, 9.—Tarsal claw of same.
,, 10.—Dorsal view of labium and mandible, *in situ*.
,, 11.—End of male abdomen in *Parosmylus* sp. (?) (undescribed) from the valley of the Tenasserim river: *a*, paired, *b*, median unpaired ventral tubercles; *c*, sperm conveyor (?).
,, 12.—Ventral view of the latter.
,, 13.—Abdomen of the male of *Panorpa fenestrata*, Ndm., in oblique lateral view: *v*, ventral appendages.
,, 14, 15.—Lateral and ventral views of same, respectively.
,, 16.—Abdomen of male of *Panorpa sordida*, Ndm., lateral view.
,, 17.—Ventral appendages of same (the tips injured).

Plate XXI.



EXPLANATION OF PLATE XXI.

FIG. 1.—Wings of *Sisyra indica*, Ndm.

,, 2.—Wings of *Annandalia curta*, Ndm.

,, 3.—Maxilla of the same.

,, 4.—Labium of the same.

,, 5.—Base of fore leg of *Parosmylus prominens*, Ndm. (male).

,, 6.—Maxilla of same.

,, 7.—Labium of same.

,, 8.—End of male abdomen, in lateral view.

,, 9.—Tarsal claw of same.

,, 10.—Dorsal view of labium and mandible, *in situ*.

,, 11.—End of male abdomen in *Parosmylus* sp. (?) (undescribed) from the valley of the Tenasserim river: *a*, paired, *b*, median unpaired ventral tubercles; *c*, sperm conveyor (?).

,, 12.—Ventral view of the latter.

,, 13.—Abdomen of the male of *Panorpa fenestrata*, Ndm., in oblique lateral view: *v*, ventral appendages.

,, 14, 15.—Lateral and ventral views of same, respectively.

,, 16.—Abdomen of male of *Panorpa sordida*, Ndm., lateral view.

,, 17.—Ventral appendages of same (the tips injured).

XIII. NEW INDIAN LEPTIDÆ AND BOMBYLIDÆ, WITH A NOTE ON *COMASTES*, OSTEN SACKEN, v. *HETEROSTYLUM*, MACQUART.

By E. BRUNETTI.

Atherix intermedia, mihi, sp. nov.

♂. West Bengal. Long. 8½ mm.

This species closely resembles both *limbata* of Osten Sacken and my recently described *calopa*, and takes an intermediate position between the two.

From *limbata* it is distinguished by an all-black thorax, with a little whitish shimmer on the humeral parts, round the edges of the dorsum and in front of the insertion of the wings; also by an oblique, whitish stripe on the sides of the thorax, which, otherwise, are wholly black, as is also the scutellum. The legs are black; the fore femora (except base and tip), the apical half of the middle femora, the middle tibiæ wholly, and the hind femora are yellow, but the latter bear a broad, deep, black band, occupying about the middle half of their length. The wing has a large, very distinct blackish brown stigma, whilst the cross-band on the wing is much darker. The abdomen is differently coloured, closely resembling that of *calopa*, except that the posterior half of the 4th and 5th segments are occupied by a whitish band, which is invisible from certain points of view. The basal half of the 5th, and the whole of the 6th segment, is black.

From *calopa*, the broad band on the hind femora easily separates it, this character being consistent in the ten specimens examined. The wing marks also distinguish it by the prominent stigma and the much more distinct apical part.

Described from ten ♂♂ in excellent condition taken by Dr. Annandale, 16-iv-09, on Paresnath Hill, West Bengal, at an altitude of 2,000 ft., on rocks at the edge of a small jungle stream, where it was present in large numbers.

N.B.—This is evidently a good species, the ten specimens agreeing exactly in all particulars, whilst the three examples of my *calopa* are also consistent; *limbata* of Osten Sacken, however, according to him, appears to be variable. My present species is best described as possessing the abdomen of *calopa* with the wing of *limbata*, with the addition of an all-black thorax and a large, black stigma.

Atherix labiata, Big.

A ♂ in my collection from Maskeliya, Ceylon, taken in March, agrees well enough with Bigot's description for me to have little doubt of its identity with his species. The pale basal third of the hind femora differentiates this species from all other Oriental ones.

Chrysopilus ornatipennis, mihi, sp. nov.

♀. South India. Long. 4 mm.

Head.—Frons blackish grey, grooved down the centre, one-fourth of width of head, only slightly wider towards vertex; ocelli on subtriangular, concolorous, slightly elevated triangle, black, with a narrow, pale border, and a few microscopic bristles. Antennæ, 1st and 2nd joints livid brown, 3rd with greyish pubescence, bristle very long. Proboscis shining, livid brown at base, bright yellow on narrow part, with two very minute dark brown hairy lamellæ. Back of head yellowish grey above, bluish grey below, with numerous minute black bristles, especially towards the vertex.

Thorax yellowish brown, the dorsum *covered with microscopic scales*, which, seen from behind, are *brilliantly emerald-green* on the centre and *bright blue* towards the sides, the posterior part and over the whole of the scutellum. In addition to the scales the entire surface of the thorax and the scutellum is covered with long curved bristly hairs. Sides of thorax uniformly shining tawny yellow.

Abdomen brownish, becoming yellow on posterior border, covered on entire upper surface rather closely with soft black hairs, which extend round the sides and are very short on the yellow belly; they are rather thicker and longer on the fore corners of the abdomen. The 5th segment is much reduced in size, blackish grey; 6th and 7th stylate, blackish grey with a broad, distinct, pale yellow posterior border, supplemented by a long, thick, cylindrical blackish grey ovipositor.

Legs.—Coxæ and femora bright tawny yellow, tibiæ pale brown, tarsi black; coxæ with some bristly hair on and around them, hind pair with a black streak on apical border; middle and hind tibiæ with two short yellow spines at extreme tip.

Wings pale blackish grey, posterior part nearly clear, light grey or nearly clear in the following places: distal ends of basal cells; middle of anal cell; a rather narrow pale yellowish band from the middle of the fore border (adjacent to the black stigma) to the distal end of the discal cell, thence becoming pale grey; a yellowish grey diffused spot just beyond (and contiguous to) the stigma. All the cells below the 3rd longitudiual vein are pale grey or clear in their centres The upper branch of the third vein bears a small appendix at the bend, which is rectangular. The inner cross-vein is placed at one-third of the discal cell, and the two forks of the upper branch of the fourth vein spring almost simultaneously from the upper corner of the discal cell. Halteres pale yellow.

Described from a single perfect ♀ from Tenmalai in the Western Ghats (Travancore State, South India), taken by Dr. Annandale, 22-xi-08 ; now in the Indian Museum.

Chrysopilus flavopunctatus, mihi, sp. nov.

♂. South India. Long. 5 mm.

Head.—Vertex very small, elevated, with the ocelli as in *ornatipennis.* Facets in upper half of eyes rather larger than those in lower half. Frons deep black ; face dark grey. Antennæ brown, third joint black, bristle long, microscopically hairy. Proboscis dusky yellowish brown ; palpi rather robust, pale brown, hairy.

Thorax.—Dorsum and scutellum dark brown, with microscopic hairs which appear bright green when seen from behind ; scutellum with some rather long black hairs. Sides shining dark brown, nearly bare.

Abdomen dark brown, nearly black towards tip, with short blackish hairs ; belly concolorous.

Legs dark brown ; fore coxæ and fore femora wholly ; posterior femora towards the tips pale ; knees black ; all coxæ with black hairs. Hind tibiæ with two pale yellow spines at tip.

Wings blackish brown ; stigma in marginal cell, elongated, deep black, extended to costa on the outer side of a short, bright yellow stripe which intersects it in the middle, this stripe also reaching to the costa.

There is a pale, parti-coloured irregular spot (yellowish and pale grey) at the distal end of the 1st basal cell, and extending below into the 2nd. Posterior border of wing fading into light grey, the veins in this part being narrowly suffused with black. Halteres pale yellow.

Described from a perfect ♂ in the Indian Museum collection, taken by Dr. Annandale at Maddathorai (Travancore State, South India), 18-xi-08.

Chrysopilus magnipennis, mihi, sp. nov.

♀. Ceylon. Long. 4½ mm : long. alar 6½ mm.

Head mainly brownish yellowish grey, a little darker here and there, especially just above the base of the antennæ. Ocellar triangle distinct. Antennæ black, the joints subequal in length, 2nd narrowly white at tip, 3rd with grey hair, style long. Palpi blackish brown, brownish grey dusted. Proboscis blackish brown, with a few hairs. Under side of head with a little black hair.

Thorax.—(Denuded.) Ground colour black, also at sides. Traces of a little grey hair and some golden yellow hairs around base of wings and on scutellum.

Abdomen black, moderately close grey hair, with which are intermixed some golden yellow ones. Belly with grey hair.

Legs wholly yellowish, except coxæ, a very narrow ring at base of femora, and the tarsi tips black.

Wings practically clear; venation as in my *segmentatus*, except that the upper branch of the 2nd longitudinal vein takes towards its tip a slight downward curve, thence curving rather sharply upwards to the costa, and enclosing a well-marked, large, dark brown stigma. Halteres: stem black, club yellowish.

Described from a perfect ♀ (except denudation of thorax and scutellum) in my collection, from Maskeliya, Ceylon, taken in August, and sent me by Mr. E. Green.

N.B.—This species should be near Bezzi's *sauteri*, but differs by the black antennæ; yellow hairs on abdomen; and the very different proportionate lengths of the body and the wings.

Exoprosopa niveiventris, mihi, sp. nov.

♀. West Bengal. Long. 18—20 mm.

Head.—Frons, at widest (level of antennæ), one-third the width of the head, narrowing at vertex to half this width; dark brown, covered with close, light brownish orange scales, which become lighter coloured below the antennæ. The whole frons is also covered with short black hairs; the ocelli are small, black, close together, placed on a small tubercle. Mouth border yellow, proboscis dark brown. Antennæ black, first and second joints thickly beset above and at the sides with strong black bristles; third joint rather long, absolutely bare, with a very distinct style, which itself bears a microscopic but distinct apical joint. From the base of the antennæ obliquely to the edge of the eye, there is on each side of the frons a narrow groove, quite destitute of scales or pubescence. Back of head broad behind the eye, with minute black pubescence, and covered towards the sides with yellowish white, soft scales, which may perhaps extend over nearly all the back of the head in some specimens. A fringe of short, bright orange-yellow hairs encircles the back part of the head, meeting the dense pubescence of the thorax.

Thorax dull black, with some short black hairs towards anterior border, and in front of the scutellum.

The front part of the thorax (not extending to the dorsum proper) is covered densely with narrow, elongated, bright yellow scales, which also extend to the sides of the thorax, and form fan-shaped bunches below each shoulder, and behind each wing. These scales become almost thick pubescence at the sides of the dorsum, being especially thick above each wing. The true dorsum is very sparsely covered with very short yellowish scales, which probably even in perfect specimens never wholly cover the surface. The scales at the sides of the thorax are more yellow than orange. The posterior calli are prominent, ferruginous, covered with irregular small black bristles, with some yellowish white long scaly pubescence on the outer side, and there are four powerful long black spines placed close together and directed horizontally backwards.

Scutellum ferruginous brown, an irregular double row of black spines on posterior margin, and short yellow scales round the

dorsum, which is quite bare in the middle, both of scales and hairs.

Abdomen.—Ground colour black, covered with microscopic black scales. Thick, scaly, whitish pubescence at the sides of the 1st segment. At the base of the 2nd segment (which is the widest) a wide band of scaly yellow-white pubescence; the remaining segments also bear similar bands at their bases, of more whitish scaly pubescence, this being shortest on the 5th segment. On the posterior borders of the 1st, 6th and 7th segments is placed a row of rather strong black bristles, directed backwards. Genital organ distinct, black, encircled towards the posterior part and at the sides by a rather thick fringe of orange hairs; the tip itself more greyish, and bearing two vertical rows (containing seven in each) of rather long, roseate scales, like the teeth of a comb. Belly black, nearly covered, except towards the tip, with close, nearly snow-white, scaly pubescence, the tip with black bristles.

Legs black. Coxæ with yellowish white scales and distinct black bristles. Femora with similar scales and short black hairs, the middle pair with two rows of short, distinct spines on under side; the hind pair with a similar row. Fore tibiæ bare; middle tibiæ beset somewhat irregularly with four rows (one on each side) of conspicuous but moderately short bristles. Hind tibiæ closely beset with dirty white, elongated scales, lying close to the surface, and intermixed with strong, moderately short, black bristles. An irregular circlet of black spines at tip, most of them on the under side. Tarsi minutely but closely pubescent, with a row of minute spines below, being longest on hind pair.

Wings pale grey, costal cell and the basal parts of all the veins ferruginous brown. Costal apparently bare, but viewed microscopically it presents a very closely placed row of minute black spines, which are conspicuous on the extreme base of the costa, where they are larger, and are intermixed with close-lying, dark greyish scales. At the extreme base of the costa is a very powerful, thick, black, curved spine. Tegulæ bright orange, with a fringe of elongated scales, which are black on outer part of the edge and dirty white towards the base. Alula of wing grey, with a fringe on posterior border of grey scales, which continue for a short distance along the posterior margin of the wing. Halteres: stem brownish, club very pale creamy orange.

Described from two ♀♀ in almost perfect condition (dorsum of thorax and scutellum may possibly have been rubbed), in the Indian Museum, taken by Dr. Annandale at the base of Paresnath Hill, West Bengal, 16-iv-09 (1,000 ft.) A conspicuous species, resembling a *Hyperalonia* of my fourth group (*Rec. Ind. Mus.*, ii, 443).

Exoprosopa ? niveiventris ♂.

? ♂. West Bengal. Long. 16 mm.

Head almost exactly as in *niveiventris*, except that the first joint of the antennæ is pale, and the back part of the head is less

puffed out behind the eyes, where it is covered closely with very small creamy orange scales. Mouth border whitish, bare.

Thorax.—Dorsum dusky olive-brown, with two faint but distinct, narrow, widely separated blackish lines. Anterior part and sides with pubescence as in *niveiventris*, except that it is whitish below the posterior calli. Scutellum as in *niveiventris*.

Abdomen as in *niveiventris*. The genital organ is concealed within the body, but is covered with whitish shimmer and fine black bristles, its tip apparently consisting of a pair of rather complex orange-coloured claspers; the upper side of the tip being covered with thick, black, bristly spines.

Legs.—The under side of the fore femora is pale, and the spines below the hind tarsi less conspicuous.

Wings wholly very pale grey, including costal cell. The veins in the middle at the base of the wing are pale orange, as are also the subcostal, third and fifth longitudinals. Halteres cream colour.

Described from a single example taken by Dr. Annandale in company with *niveiventris* ♀, of which species I conclude the present specimen is the ♂. The frons is barely appreciably narrower, therefore the narrowness of the back of the head above, the difference in shape of the genital organs, and the nearly clear wings are the only points in which it materially differs from the previously described species.

Exoprosopa collaris, W.

One from either the Kangra Valley (4,500 ft.) or Sikkim.

Argyramœba obscurifrons, mihi, sp. nov.

♀. Simla district. Long. 7 mm.

Head.—Frons moderately wide at vertex, increasing to double the width at level of antennæ, where it forms one-third the width of the head; grey, with blackish patches; covered rather thickly with black hairs and with some whitish scales intermixed just above the antennæ. Ocellar triangle distinct, small, with some hairs. Antennæ, first and second joints black, bristly; third grey-dusted, bare, apical style rather short. Under side of head blackish grey, a moderately thick band of bristly hairs across lower part of face. Proboscis withdrawn, apparently dark brown. Back of head dark grey, minutely pubescent, some minute pale scales just behind the eyes, which latter are black.

Thorax.—Dorsum blackish grey, with a rather thick fringe of bristly hair in front, reaching over the shoulders and continued below. Bristly hairs between the shoulders and the roots of the wings. Sides lighter grey, with occasional whitish reflections, nearly bare. Scutellum blackish grey, with soft black hair.

Abdomen black, covered mainly with soft black hairs. A thick bunch of white hair on each shoulder, behind which, on the

posterior border of the 1st segment, near each side, are a few snow-white scales. There is also a row of white scales (more or less interrupted in the middle) to the posterior border of the 2nd segment, and another on the last segment. Belly black, softly pubescent, some whitish hairs in centre, and a longitudinal stripe of short yellowish hairs near the tip.

Legs black, minutely pubescent; femora with a little soft black hair below; posterior tibiæ with short bristles on outer and hinder sides.

Wings very pale grey, with the oblique baso-costal dark brown band occupying nearly half the wing, passing across the middle of the discal cell (where it is somewhat extended) to the hind margin of the wing which it reaches just before the tip of the anal cell. The colour is extended also from the costa to about the middle of the first posterior cell, enclosing a clear spot near the base of the first submarginal cell, and another near the base of the first posterior cell. On the outer cross-vein there is a circular spot, and a trace of a small one on the costa, near the tip of the marginal cell. Halteres yellowish.

Described from a single specimen taken by Dr. Annandale at Phagu (9,000 ft.), Simla district, 14--15-v-09.

Argyramœba limitarsis, mihi, sp. nov.

♀. Western Himalayas. Long. 5 mm.

Head.—Frons one-fourth of head at vertex, widening to one-third at level of antennæ, with rather thick brownish black hair. Ocellar triangle inconspicuous. Face blackish, with hair which from above appears whitish grey. Antennæ, first joint black (remainder absent). Proboscis withdrawn, apparently, with mouth border reddish brown. Back of head only slightly puffed out, blackish grey, with some whitish hairs.

Thorax shining black, with some yellowish white hair, and stiffer bristles towards the posterior corners. Sides of thorax black, with some whitish hair. Scutellum dark cinereous grey, with vestiges of some short yellow hair, and a few pale yellow bristles on posterior margin.

Abdomen blackish grey, with a slight brownish fringe, covered more or less sparsely with short pale yellow hair, most conspicuous on borders of segment. A bunch of whitish hair on each shoulder of the 1st segment. Belly with whitish hair.

Legs.—Coxæ yellowish grey with whitish pubescence. Femora and tibiæ pale yellow, the latter with minute bristles; tarsi blackish towards tips.

Wings nearly clear. A rather bright yellowish brown baso-costal band extends along the costa just beyond the middle, thence extending posteriorly along a line comprising the inner cross-vein, the base of the discal cell, and the outer side of the second basal cell. Below this cell the colour immediately fades away to a pale

grey, which covers the anal and axillary cells. Appendiculation of the upper fork of the second vein short but distinct. Halteres creamy yellow.

Described from a perfect specimen (except the missing antennæ) in the Indian Museum from Hathikund, Garhwal district, base of Western Himalayas, 3-v-09.

N.B.—The species falls in the central one of my groups in this genus.

Argyramœba claripennis, mihi, sp. nov.

♀. Punjab. Long. 7 mm.

Head.—Frons one-fourth width of head at vertex, broadening at level of antennæ to one-third; dark grey, with yellowish hair, which on the face becomes greyish or nearly white. Ocellar triangle inconspicuous. Antennæ black, with the upper sides of the joints greyish; basal joints with rather thick hair; bisection of style obvious, pencil of hairs small. Proboscis dark, withdrawn. Back of head dark grey, with thick yellowish grey hair in the middle.

Thorax.—Dorsum blackish grey, with short yellow hair, of which a bunch of paler colour is placed on each shoulder; a long and a shorter yellow spine in front of each wing, and five or six long yellow bristles towards each posterior corner, also some yellow bristles towards posterior margin of dorsum. Scutellum dark grey, with short yellow hair, and some yellow bristles on posterior margin. Sides of thorax ash-grey, white dusted, with a bunch of greyish white hair below each shoulder, and whitish hairs below this again.

Abdomen blackish, hardly shining, posterior margins of segments with rather wide, light brown bands. Whole dorsal surface apparently covered with short, soft, bright yellow hairs which become longest towards the sides on the posterior margin of the anal segments; where the brown segmental margins are also widened.

Belly blackish grey, with minute elongated whitish scales; belly becomes reddish yellow towards tip. There are two long pendent bristles towards the posterior margin, about the middle of each ventral segment. Genitalia not conspicuous but withdrawn.

Legs uniformly pale yellow except blackish towards the tarsi tips. The coxæ and femora are rather thickly, the tibiæ slightly, covered with minute whitish woolly scales, the tibiæ bearing moderately short black bristles in addition, as do also the hind femora near the tip. There is a row of microscopic bristles on the hinder side of the hind tibiæ.

Wings quite clear; submarginal cell brownish yellow; appendiculation not obvious; upper branch of second vein forming a very distinct downward loop towards its end. Halteres yellow.

Described from a single perfect example in the Indian Museum collection from Lahore, 8-v-08.

Argyramœba nigrofemorata, mihi, sp. nov.

♂. Western Himalayas. Long. 5 mm.

Head.—Frons very narrow, about one-twelfth of the width at vertex, enlarging to nearly one-third at level of antennæ; dark grey in colour, becoming gradually ash-grey on the face below the antennæ. Frons with moderately thick black hair; face with thick soft white hair. Antennæ black, normal, bisection of style distinct, pencil of hairs very short. Proboscis brown. Back of head ash-grey, with minute pubescence and some rather short thick yellowish hair towards lower part.

Thorax—Dorsum blackish grey with short yellow hairs intermixed with stiff short black bristly hairs; anterior margin with rather long bristly yellow hair; a longer and a shorter yellow spiny bristle in front of each wing base. Sides of thorax light grey, with pale yellowish or whitish hairs. Scutellum concolorous with thoracic dorsum, and with some longer bristles towards posterior margin.

Abdomen subconical, blackish grey, with soft short yellow hairs. Belly mainly yellow with longer yellow hair. Genitalia apparently large and complicated, but withdrawn.

Legs.—Coxæ blackish, with reddish yellow tips and whitish hairs; femora black, with bases and tips reddish yellow, whitish grey scales and a little soft whitish hair below; tibiæ reddish yellow, with small black bristles, and with thicker shorter black bristles on hinder side, all the bristles on the hinder pair being stronger than on the other pairs; tarsi brown, closely pubescent, black towards tips, pulvilli yellow.

Wings quite clear; subcostal cell yellowish brown; appendiculation distinct; upper branch of second vein forming very distinct downward loop towards its end. Halteres rather deep yellow.

Described from a perfect ♂ in the Indian Museum collection taken at Hathikund, Garhwal district, base of Western Himalayas, 3-v-09.

Argyramœba duvaucelii, Macq.

Redescription.

This species was first described under *Anthrax*, and I retained it in this genus in my recent paper; but a number of specimens recently obtained by the Indian Museum afford me the opportunity of recognising it as a true *Argyramœba*, the pencil of hairs at the tip of the antennal style being conspicuous, whilst the anterior branch of the third longitudinal veiu shows a strong tendency to appendiculation, although it is actually appendiculated in one specimen only, in which, moreover, an additional veinlet (in one wing only) produces the particular submarginal cell characteristic of *Hyperalonia*. As this species was very insufficientlv described by its author, I venture to append a redescription.

♂ ♀. *Long.* 8—10 mm.

Head.—Frons at level of antennæ, one-third the width of the head, narrowing at vertex to one-third of this width (♂) or about half this width (♀); blackish grey, with short, soft black hairs. Face with moderately long and thick white hair. Mouth border very narrowly yellow; proboscis dark brown, shining, hairy.

Antennæ black, with a little greyish white shimmer; first two joints with black bristles, third bare, prolonged into the usual style, which is pale at the tip, the pencil of hairs quite distinct. Vertex of head with a distinct but short and deep indentation, which is almost better described as a *hole*, from which a central dark grey hairy protuberance arises, bearing the red ocelli, placed closely together.

Thorax dark cinereous, the dorsum with sparse yellowish short hairs round the edges. Anterior part of thorax with a dense fringe of very narrow long greyish white scales, intermixed behind with long, soft, black hairs, these latter continuing more or less over the whole dorsum, but rather shorter.

Sides of thorax with greyish white long thick scaly pubescence, thickest and most scaly below the humeral region; thinner, shorter and whiter posteriorly. It extends somewhat sparsely above the insertion of the wings. Scutellum blackish cinereous, covered with rather sparse but long soft black hairs and with traces of a little short yellow hair around the whole scutellum. A row of stiff hairs on posterior margin. Several strong black spines below the edge of the dorsum anterior to insertion of wing; the posterior calli also, moderately conspicuous themselves, bear a few stiff long bristles.

Abdomen blackish grey, 2nd segment distinctly but not greatly longer than the five remaining ones. The whole dorsum apparently covered with small yellowish white or quite white scales, which may be thickest at the bases and posterior margins of the segments. The whole surface is also covered lightly with moderately long, soft, black hairs, and there is a bunch of long whitish scaly pubescence at each side of the first segment. This pubescence is continued along the sides of the abdomen. Belly blackish, with short white hairs; longer white pubescence towards the base and the last segment (in the ♂ only), with rather closely placed, somewhat large and elongated snow-white scales, which sometimes spread over the last two, or even three, segments and extend round over the sides.

In the ♀, these white scales below the abdomen are absent, and are replaced by long black hair on the ultimate segment. The genital organs in the ♂ consist of a pair of stout upper claspers (?), the apical half tapering to a blunt point, each with a small lamella at the tip. This large organ is rufous brown, a little blackish above at the base, and with some reddish yellow hairs on the inner sides. Below these large claspers are some further, apparently complex organs which are not easily visible, the whole being protected by a large,

black, curved ventral plate, bearing on its margin reddish hair near the base and black hair posteriorly. In the ♀ the genital organs consist of a rather large subconical process with dense reddish or yellowish hair. In one example this organ is almost wholly withdrawn within the abdomen.

Legs black. Coxæ with rather long silky white hair; femora and tibiæ with small whitish scales, which extend, more sparsely, to the tarsi. All the femora with soft hairs below and some irregular weak bristles. The tibiæ generally with small, apparently irregularly placed spines, the most regular being a row on the outer side of the hind tibiæ. All the legs minutely pubescent.

Wings almost clear, first posterior cell rather widely open; fifth generally narrowly open, but in two specimens closed exactly on the margin; the lower side of the discal cell occasionally with the beginning of a very small appendix. Costal cell and extreme base of wing, brownish yellow; subcostal cell dark brown, very narrow. Fork of the third longitudinal vein sharply angled, and with only a tendency to appendiculation (which actually occurs only in two or three specimens, in two of which, moreover, there is an additional veinlet in one wing only, this veinlet producing the cell usually characteristic of *Hyperalonia*).

A dark brown suffusion, distinct but small, occurs at the base of the second vein, joined to that over the inner cross-vein; suffusions also at the angle of the fork of the third vein; over the outer cross-vein, the colour carried upwards along the inner side of the discal cell; also over the lower extremity of the veinlet, connecting the two branches of the fourth longitudinal.

Costa minutely spinose, with the usual spiny portion at the base. Halteres light brown, tip of club creamy. Tegulæ milk-white, with snow-white hair. Alulæ concolorous with wing, bearing a fringe of minute black hairs.

Described from several of each sex taken at Bhogaon, Purneah district (N. Bengal), 19—26-iii-09, by Mr. Paiva. These were in good condition and quite uniform in the specific characters. The Indian Museum also has a specimen from Sahelwa, Bahraich district (United Provinces, India), 11-iii-09 [Hodgart].

Argyramœba fallax, Meij.

One ♀ from Calcutta, 1-vi-09, presuming my previous identification of the species to be correct.

Argyramœba distigma, W.

Several taken by Dr. Annandale, 16-iv-09, at Paresnath (West Bengal) on the edge of a small mountain stream at an elevation of 2,000 feet, and again at an elevation of 4,400 feet. One ♀ from Jalaban, in the plains of the Naini Tal district, 21-v-09.

Anthrax afra, F.

Two from Pipera, Gonda District (United Provinces, India), 9-iii-09, taken by Mr. Hodgart.

Anthrax insulata, Wlk.

Four headless specimens from Kumdhik, Nepal Terai, 22-iii-09, but undoubtedly this species. Also a ♀ in good condition from Pipera [Hodgart].

Anthrax himalayensis, mihi, sp. nov.

♀. West Himalayas. Long. 6½—11 mm.

This species very closely resembles *maura*, L., of Europe, and for some time I was doubtful as to its specific distinctness, the first two specimens seen by me coming from Naini Tal, taken in May or June, 1893 (from the Lucknow Museum, now in the Indian Museum collection).

However, on Dr. Annandale capturing five further examples in the Simla district (7,000 to 9,000 ft.), 12—16-v-09, I have no hesitation in considering the form distinct, though allied very closely to *maura*, which must therefore be deleted from the Oriental catalogue.

The difference, though not great, is invariably consistent in the seven specimens before me, compared with four specimens of *maura* from Europe.

1. The abdominal bands of hair are white, not yellow.

2. The basal dark half of the wing bears no narrow pale yellow spaces around the cross-veins of that region as is the case in *maura*; but there is a small oval sub-hyaline spot in the upper corner of the first basal cell, with a narrow transverse streak above it, both these being weak or absent in *maura* (see text-figs. 1 and 2).

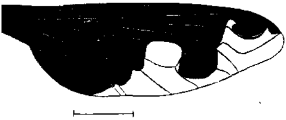


FIG 1.

FIG. 2.

FIG. 1.—Wing of *A. himalayensis.*
,, 2. ,, ,, ,, *maura.*

3. The lobe of the dark part (which in *maura* extends broadly to the posterior margin of the wing) attains only the middle of the second posterior cell, where it is rounded off; and the apical portion of the dark part, near the tip of the wing, more nearly forms a small additional lobe than in *maura.*

4. In *maura* there are generally a few very small pale spots towards the upper and outer part of the dark portion of the wing. These are altogether absent in *himalayensis*, in which the dark colour, moreover, is in some specimens quite black, in others dark brown.

N.B.—The remains (a thorax and upper part of each wing) of a large specimen in the Indian Museum (without history) bears a label " *A. bidens* Big., n. sp. Ind." It evidently is a specimen of my new species.

Anthrax aperta, Wlk.

Four examples taken by Dr. Annandale at Simla, 16-v-09, agree very closely with those in the Pusa collection and from Mussoorie previously referred to this species by me.

Taken on *Sedum* and the common marguerite.

Anthrax aureo-hirta, mihi, sp. nov.

♂. Calcutta. Long. 5 mm.

Head.—Frons at vertex one-eighth width of head, widening to barely double this width at the level of the antennæ; black, slightly shining. Ocelli on small raised tubercle.

Face black. Some white dust on each margin of the lower part of frons and of the face, and yellow and black short hair intermixed, above and below the antennæ, which are wholly black, the first two joints bearing some stiff black hairs, the third, soft white microscopic pubescence. Proboscis somewhat large, blackish at base, brownish towards tip, with some hairs.

Eye margins rather deeply cut away at the middle of the side. Back of head considerably puffed out, black, with golden yellow hair at the sides and a fringe of stiff bright yellow hair at the back, and with microscopic black hairs on the remaining portions.

Thorax.—Dorsum black, with short, not thick, bright golden yellow hairs, also a bunch of bristly yellow hair on each side, just behind the shoulder, with some yellow bristles; some yellow hair on anterior margin. A large reclinate yellow spine above each wing base and three or four black bristles on posterior portion of dorsum. Sides of thorax ash-grey, with some patches of whitish hair. Scutellum black, with golden yellow hair, and some black bristles towards posterior margin.

Abdomen moderately shining black, rather closely covered with short, bright golden yellow hair, which forms a large fan-shaped bunch on each side of the 1st segment, where it becomes almost scaly. There are short black hairs intermixed with the yellow towards the sides of the dorsum. Belly with close, soft, bright yellow hair.

Legs.—Coxæ black, with whitish hair; femora and tibiæ yellow, with short black bristles, which are longest on the latter,

and form a circlet at the tibiæ tips; tarsi black, with very short pubescence and bristles.

Wings very pale brown up to just beyond the middle where the colour fades away. Halteres creamy yellow.

Described from a unique specimen in perfect condition in the Indian Museum collection, from Calcutta, taken 1-vi-09.

N.B.—This species does not quite fall naturally into any of my temporary divisions of this genus, as the darkening of the wing does not partake of the usual oblique form; the coloration extending over the whole basal half of the wing.

Bombylius scintillans, mihi, sp. nov.

♂. South India. Long. 5 mm. without proboscis, which measures 3 mm.

Head nearly as broad as thorax, black; eyes barely contiguous, but for about half the distance from the vertex to the antennæ; facets divided horizontally, those of upper half of eye much larger. Vertex distinct, ocelli red. Antennæ and proboscis entirely black, the former with microscopic white hairs on 3rd joint seen under a microscope. Bushy long black hair at the base of the antennæ, on the face and on under side of head. Some *elongated silvery white scales* in a row across the frons just above the antennæ, and more numerous ones in a small patch of them on each side of the face. The *surface* of the face itself is silvery white with a faint bluish shimmer when seen in certain directions. Back of head blackish, covered on upper part with bushy bright yellow hair, and on lower part with long black hair.

Thorax.—Surface deep velvet-black, with some black hairs at the sides and round the bases of the wings. The anterior part of the dorsum with bright yellowish hairs. (The surface is denuded posteriorly, but bears a few white scales with which it may normally be covered, but which may have accidentally come from the abdomen.) Scutellum black.

Abdomen dull shining black, bare of hairs on dorsum; a few at sides and on the wholly black belly. A thick row of *silvery white scales* at the posterior border of each segment, and distributed over the surface; in perfect specimens the dorsum of the whole abdomen is probably covered with them.

Legs black, with minute bristly pubescence on tarsi; middle femora with soft black hairs below; hind femora with several spiny bristles below; posterior tibiæ with numerous bristles.

Wings deep smoky brown, nearly black at base and on basal part of costa; posterior border paler; a blackish spot on upper angle of 2nd basal cell. Haltères black.

Described from a unique ♂ in perfect preservation (except for some denudation of the thorax and abdomen) in the Indian Museum, captured by Dr. Annandale at Kulattupuzha, at the western base of the Western Ghats (Travancore, South India), 19-xi-08.

Bombylius comastes, mihi, sp. nov.

♀. South India. Long. 3¾ mm. + proboscis 2 mm.

Head.—Frons as broad as thorax, dark olive-brown, with some long erect black hairs; two large oval raised spots, concolorous just below vertex. Ocelli distinct, small, bright red, situated at extreme vertex, at which is a small bunch of long black hairs. Antennæ black, first joint with rather long black hair, style of third joint minute. Mouth, proboscis and under side of head black. A small cluster of *snow-white scales* on the face at each side of the antennæ, with a larger cluster of longer ones immediately below the smaller cluster, some few isolated small similar scales scattered along the mouth border. One or two small similar scales are placed on each side of the frons, just below the vertex, on the raised spots. Back of head grey, with thick yellowish hair on upper part, and a row of snow-white scales behind the outer orbit of eyes, for a considerable distance.

Thorax.—Ground colour velvet-black; dorsum partly denuded but with some small scales remaining of a brilliant emerald-green hue, while in front of the base of the wings are some small snow-white scales. Anterior part of dorsum with yellowish hair, some yellowish hair on sides and snow-white ragged hair on the lower part of the thorax in front. Black bristly hair appears scattered sparsely over the thorax, with a few bristles near the base of the wings. Scutellum dull black (denuded), with traces of green scales similar to those on the thorax.

Abdomen.—Ground colour dull black; traces of variegated scales, emerald-green, pink and white; some grey hair at sides of 2nd segment, with a few snow-white scales, which latter also appear to occur at the sides of the 4th segment. The sides of the abdomen and the whole of the tip bear long black hairs, as does also the belly.

Legs black, hind femora and posterior tibiæ with short spiny bristles. Some yellowish grey long hair around the coxæ.

Wings clear. Costal cell pale yellowish brown on distal half. Wings at base (including the tegulæ) similarly coloured, up to the base of the basal cells which are absolutely colourless. *The veinlet closing the first posterior cell* is in a direct line with that joining the two branches of the fourth longitudinal, the venation otherwise being that of normal *Bombylius*. Halteres black.

Described from a single ♀ (perfect except for some denudation of the thorax and abdomen) in the Indian Museum collection, taken by Dr. Annandale at Trivandrum (Travancore State, South India), 13-xi-08.

N.B.—In the unusual venation referred to, this species resembles the genus *Comastes*, Os. Sac., but, possessing neither the remarkably long antennal style nor the distinct emargination of the eyes characteristic of that genus, it must remain in *Bombylius*. The broad head, as wide as the thorax, is also characteristic of

Comastes, in opposition to the usually comparatively small and narrow head in typical *Bombylius*.

Bombylius vicinus, mihi.

Two ♀ ♀ from Kumdhik, Nepal Terai, taken in company with *Anthrax insulata*.

Bombylius propinquus, mihi, sp. nov.

I have a ♂, taken at Haragama, Ceylon, in January 1908, which closely resembles *terminalis*, mihi, but, intermixed with the yellowish brown soft hair on the front part of the head, are numerous long black bristly hairs. There is no snow-white pile around the antennæ; the lower part of the head is brownish yellow (not white), and without white hair; the base of the proboscis is yellow, and there is no snow-white pile at the abdomen tip. The wings have a blackish brown baso-costal band, occupying nearly half the surface of the wing; 1st posterior cell closed some distance from the border. The proboscis is 4 mm. long; the whole insect only 5 mm. From my *vicinus* it is also distinguished by the wholly black antennæ. Type in my collection.

Bombylius wulpii, mihi.

Bigot's description of the ♂ of this species is quite good. It is very unlike the ♀, as it has the last four segments of the abdomen (except the extreme tip) snow-white. I recently received a ♂ and ♀ from Mr. E. Green, taken *in cop.*, at Peradeniya, Ceylon, in April 1909.

Systœchus socius, Wlk.

One ♀ from near Theog, Simla district, 14-v-09 (7,000 ft.), taken by Dr. Annandale, agrees very well with Walker's description.

Dischistus resplendens, mihi.

Four ♀ ♀ taken by Dr. Annandale on a hillside below Theog (Simla district), 14-v-09.

N.B.—The suggestions in my description of this species, as to the normal appearance of it in perfect condition, are fully borne out by the above four perfect examples. Dr. Annandale describes this species as hovering slowly over banks of wild thyme, with its hind legs curved upwards, and as having much the appearance on the wing of a large mosquito, such as *Toxorhynchites*; the proboscis being extended in front of the head adds to the resemblance, while the glittering scales give the insect a splendour comparable to that of *T. immisericors*, Wlk., which in life is one of the most gorgeous of Indian Diptera.

Usia sedophila, mihi, sp. nov.

♂ ♀. Simla. Long. 2¾—3½ mm.

♂ *Head.*—Vertex prominent, black, shining; a few erect long hairs. Ocelli distinct, whitish. Eyes black, bare, contiguous for more than half the distance from vertex to antennæ; facets in front and above distinctly larger than those behind and below, but no distinct dividing line. Antennæ black, bare, except for an occasional hair; first two joints short, third somewhat flattened, but thick and slightly curved, elongate, and with a peculiar notch towards the tip on upper side in which is a single hair.

Proboscis about twice the length of the head, black, cylindrical, stiff, straight, bent upwards at tip, bare, except for a few minute hairs at tip. Face dark greyish, with some stiff black hairs on each cheek, and a long, elevated, shining black callus between the median line and the eye margins. Back of head black, not produced behind margins of eyes, with long sparse black hairs, continued on under side of head.

Thorax dull black, velvety on dorsum, some black and pale hairs towards the sides, and three whitish grey elongate spots on anterior border, of which the middle one is often absent, and the outer ones are occasionally indistinct or absent also. Lower part of thorax more or less dark grey. Scutellum black, with some erect light tawny hairs.

Abdomen dull black, conical, 1st segment narrow, wholly black, the remaining six broader, but of diminishing length and breadth to the tip, and with a rather bright yellow narrow posterior border to each segment.

Dorsum comparatively bare, but the sides of the abdomen with pale yellow hairs. Genitalia small, inconspicuous, conical, blackish. Belly blackish, posterior margins of segments whitish grey.

Legs uniformly black, very shortly pubescent; femora with a little soft hair; hind tibiæ with short bristles.

Wings nearly clear; subcostal cell pale yellow, venation normal. Halteres dark brown or blackish, knobs large.

♀. In this sex the eyes are separated by a wide frons equalling one-third of the head. The upper half of the frons, as also the whole back of the head, is greyish yellow, the latter with black hairs as in the ♂; the upper half of the frons with a row of hairs near the margin of the eyes. Vertical triangle distinct, dark. Two narrow fuscous vertical lines lead from the vertical triangle to an irregular transverse dark streak dividing the upper from the lower half of the frons, the latter part being more ash-grey and unmarked. Lower part of the head greyish. Proboscis and mouth larger than in the ♂, thus narrowing the cheeks considerably.

Thorax yellowish grey, with median pair of narrow fuscous lines, with an outer broader stripe, more or less divided into three

spots, the anterior one small and conical, the other two more elongate. There is also an indistinct central line between the median pair of narrow ones, and a small spot above the insertion of the wings. Sides of thorax, cinereous grey. *Scutellum* yellowish grey, with some yellow hairs as in ♂.

Abdomen black, bare, posterior margin of segment rather broadly yellow, sides with a little less hair than in ♂. Belly blackish. Ovipositor pale yellow, inconspicuous.

Legs and *wings* as in ♂.

Described (♂ ♀) from several of both sexes taken by Dr. Annandale at Simla, 16-v-09, where it was common on *Sedum rosulatum* (white stone-crop); the species was not seen anywhere except on this plant.

Usia marginata, mihi, sp. nov.

♂. Simla. Long. 4 mm.

Head.—Eyes contiguous for a shorter space than in *sedophila*, black, bare; upper facets larger than lower, and more sharply defined from one another than in *sedophila*. Frons ash-grey, small, with a few black hairs. Vertex prominent, with some black hairs, ocelli distinct. Front margins of eyes and cheeks with long black hair, which is considerably thicker on the under side, and which extends over the whole of the back of the head. Antennæ as in *sedophila*, but the third joint with a pale ring at the base, giving the appearance of a minute basal joint, and the tip bears on its upper side a minute style-like process, just beyond the sub-apical depression. First joint with some bristly black hairs, second with one or two minute hairs, third bare.

Thorax dull black, almost velvety, covered lightly on dorsum, and more thickly in front and at sides with long black hairs. Anterior margin of thorax broadly whitish grey, which in the centre is produced posteriorly into four narrow stripes, of which the outer pair just reach the suture, the inner pair being very slightly shorter. Sides of thorax black, with long black hairs, and the whitish grey colour of the anterior margin of dorsum extends downwards somewhat below the shoulders.

Abdomen dull black, posterior margins of segments narrowly yellowish, with the colour continued over the sides and across the belly. A row of grey hairs on posterior border of segments, and the sides of the abdomen with rather thick whitish grey hair. Belly concolorous.

Legs black, minutely pubescent; femora with rather long soft black hair on upper and lower sides; hind tibiæ very shortly bristly.

Wings nearly clear; subcostal cell very pale yellow. Halteres pale brown, clubs chalk-white.

Described from one ♂ taken by Dr. Annandale at Simla (16-v-09) in company with the previous species.

Geron albescens, mihi, sp. nov.

♂. Orissa Province (Bengal Presidency). Long. 5 mm.

Head black. Eyes contiguous almost to the antennæ, reducing the frontal triangle almost to a point. Facets of uniform size. Vertex considerably raised, small, with some rather short black hairs; ocelli red. Mouth black, grey bordered; face small, squarish, black, a cluster of drooping snowy scales on each side of the base of the antennæ Proboscis black, tip curled. Antennæ black, microscopically grey dusted, tips of first and second joints narrowly pale, which joints are covered with greyish hair. Back of head black, long yellow hair above and greyish below. Some white small scales on hind border of eyes.

Thorax velvet-black; dorsum covered with bright yellowish hair, which on the shoulders becomes greyish, below which can be seen the humeral calli, grey, perforated with small holes. Under side ash-grey, covered with loug grey hair and some grey scales. Scutellum black, yellow-haired.

Abdomen black, covered close to the surface with small recumbent yellow hairs; each segment bearing on its extreme posterior border a row of long deflexed grey hairs. Sides with somewhat thick and long grey hair. Belly wholly covered with small silvery white scales and long grey hair.

Legs (fore legs missing) pale tawny, with a pinkish white microscopic pubescence; coxæ, tips of femora, hind tarsi wholly, and middle pair towards tip, black. Middle femora with a little soft hair below.

Wings quite clear, veins pale yellowish on basal half. Halteres yellowish, knob bright lemon-yellow.

Described from a nearly perfect ♂ in the Indian Museum collection, taken by Mr. Cauuter at Balugaon, Puri district of Orissa, on the east coast of India, 14-xii-08.

NOTE ON *COMASTES*, Os. Sac.

This genus, I am convinced, is not Oriental, although the late Herr van der Wulp removed a species of his own (*pulchellus*) from *Bombylius* to this genus. Described first in the Tijd. voor Ent., xxiii, 164, with an excellent plate (plate x, fig. 8) giving the full insect, he referred it to *Comastes*, in Notes Leyd. Mus., vii, 85. It is, however, certainly not a *Comastes*, as that genus possesses three characters which are altogether absent in *pulchellus*; these are the long style, as long as the third antennal joint itself, the emarginated eyes, and the punctiform contact of the second submarginal with the first posterior cell. There can be no possible doubt that a perfect specimen, a female, captured recently in South India by Dr. Annandale, belongs to this species, being identical with van der Wulp's description and plate, and it is far too brilliant and conspicuous a species to be mistaken. Moreover that

author distinctly says an "extremely small" style, referring to his species, and the plate distinctly shows the normal venation of *Bombylius*, and not that described by Osten Sacken.

The head is as broad as the thorax in *pulchellus*, and in that character alone it differs from the typical *Bombylius*, in which genus it must therefore remain.

A second question is whether *Comastes* or *Heterostylum*, Macq., should stand. Prof. Aldrich adopts the latter in his recent Cat. N. Amer. Diptera. Osten Sacken admits the identity of the two genera (Cat. N. Amer. Dipt., Add., p. 267, 1878) but upholds his own generic name on the ground that Macquart's principal character, the pubescence of the third antennal joint, had no existence in reality, O ten Sacken having examined the type in Bigot's collection and found the supposed pubescence to be dust. The two other characters of the genus admitted by Osten Sacken, namely the emarginate eyes and the venation mentioned above, were, however, also given by Macquart in his diagnosis.

Osten Sacken has himself remarked somewhere that a generic name founded upon an absolutely incorrect character seems justly to require alteration, as being scientifically wrong and misleading, but the name *Heterostylum* is not intrinsically incorrect, for though the alleged pubescence is not present, the antennal style is sufficiently differently formed (Macquart distinctly says "la forme du style, differente," etc.) to justify the retention of his name.

Therefore, because it may be regarded from this point of view, I think *Heterostylum* should stand. The genus, however, has not yet been found in the Orient.

[*N.B.*—The types of all the new species described in this paper are in the Indian Museum collection, except where otherwise stated.]

XIV. NOTES ON THE TRICHOPTERA IN THE COLLECTION OF THE INDIAN MUSEUM.

By C. Betten.

This collection includes thirty species of Trichoptera of which eleven are described below as new. Among these thirty species there were some which are listed in this paper, the specimens of which were not in condition to admit of specific description. There were in addition a couple of species of Limnophilidæ and a *Rhyacophila* unfortunately so much damaged that they cannot be dealt with at all prope ly. In the case of most of the already described species referred to, notes and drawings are here added in the hope of improving our knowledge of these forms. The nomenclature of the wing veins adopted is not that commonly used in this order. I have therefore labelled veins only in those cases in which it was necessary to make the references in the text iutelligible. In studying this collection it has been very convenient to have for reference Ulmer's list of Indian Trichoptera.[1]

Fam. PHILOPOTAMIDÆ.

Gen. Stenopsyche.

[*Stenopsyche griseipennis.*]

[*Stenopsyche griseipennis*, McLachlan, *Trans. Ent. Soc. Lond.* (3), vol. v, p. 265, pl. xvii, fig. 5 (1866); *Journ. Linn. Soc. Lond.*, Zool., vol. xi, p. 134 (1871).
,, ,, Ulmer, *Cat. Coll. Sélys*, fasc. 6, p. 77, figs. 116, 117 (1907).
,, ,, Ulmer, *Genera Insectorum*, fasc. 60, p. 201.

Numerous specimens of both sexes from Sikkim, Kulu (W. Himalayas) and Kurseong, Darjiling district (alt. 5,000 ft.). At the last place I found the species common in the last week in May, in 1906.

Unfortunately Dr. Betten's MS. has been damaged in transit, and the page containing his notes on this species is missing. The

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[1] Ulmer, Georg: *Notes from the Leyden Museum*, vol. xxix.

specimens referred to have been named by him. There are also specimens in the Museum which agree with them exactly, from Calcutta, Ramnee in British Garhwal, W. Himalayas (21-x-07), and Manipur, Assam.—*N. Annandale.*]

Fam. HYDROPSYCHIDÆ.

Subfam. *MACRONEMATINÆ.*

Gen. MACRONEMA.

Macronema fastosum.

(Pl. xiv, figs. 4—7.)

Macronema fastosum, Walker, *Cat. Neur. Brit. Mus.*, p. 76.
,, *fasciatum*, Albarda, *Veth's Midden-Sumatra*, vol. iv pt. 5, pl. v, fig. 2 (1881).
,, ,, Ulmer, *Stett. Ent. Zeit.*, vol. lxvi, p. 72.
,, *fastosum*, Ulmer, *Notes from the Leyden Museum*, vol. xxviii, p. 73.
,, ,, Ulmer, *Genera Insectorum*, fasc. 60, pl. xxxix, fig. 7.

Ulmer has shown that *Macronema fasciatum*, Albarda, is a synonym of *M. fastosum*, and *fasciatum* is thus reduced to a variety. The half dozen specimens at hand all belong to the typical variety. One of the specimens is labelled "Sikkim" and they all agree in general with the description Ulmer gives of his material from that region, although there is a little variation in the extent and depth of the colour of the fore tibiæ. None of the descriptions call attention to the fact that the tips of the hind wings are black. The two veinlets in the costal area of the fore wing and the slender filaments on the posterior margin of the fourth abdominal segment seem also to have escaped notice. Figures are here added because those by Albarda are in a publication not universally accessible and they are not wholly accurate, as Ulmer has indicated.

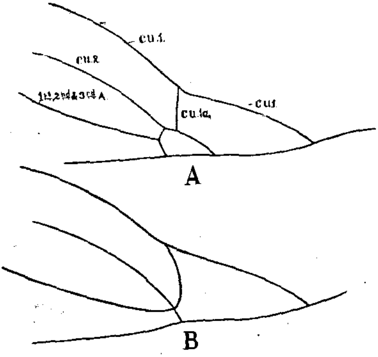
[I found this form very common at Kurseong in May, 1906. Numbers flew to the lamp in my room every evening.—*N. A.*]

Macronema punctatum, sp. nov.

This species is undoubtedly closely related to *M. fastosum*, from which it differs in the following particulars. The length is 10 mm., the wing expanse 31 mm. The largest specimen of *M. fastosum* I have has an expanse of 26 mm. There is no trace of black on the tips of the wings of this species, and in the middle of the fore wing there is a black spot, not much longer than wide, instead of the band which occurs in *M. fastosum*. The most decided difference is in the venation. The difference in the course of branches of cubitus and anals near the wing-margin is shown in

the text-figure. I find no differences in the genitalia of the two species.

One male specimen from Kulu, W. Himalayas.



Tips of cubitus and the anals of the fore wing of, A, *Macronema fastosum*; B, *M. punctatum*.

Gen. POLYMORPHANISUS.

Polymorphanisus nigricornis.

(Pl. xiv, figs. 8, 9.)

Œstropsis nigricornis, Walker, *Cat. Neur. Brit. Mus.*, p. 79.
,, ,, McLachlan, *Ann. Soc. Ent. Belg*, 1872, p. 70.
,, ,, Brauer, *Verh. Zool.-Bot. Ges. Wien*, vol. xxv, p. 73.
Polymorphanisus nigricornis, Ulmer, *Ann. Soc. Ent. Belg.*, vol. xlix, p. 24, fig. 11.

There are in the collection a male and a female specimen of this species. They agree well enough with Walker's description. They have the two black spots on the mesonotum as described for *P. bipunctata*, Brauer, but not mentioned in the original description of *nigricornis*. I add complete figures of the venation and of the genitalia.

[One of these specimens is from Cachar, Assam.—*N. A.*]

Gen. ÆTHALOPTERA.

Æthaloptera sexpunctata.

(Pl. xiv, figs. 10—12.)

Setodes sexpunctata, Kolenati, *Genera et Spec. Trichopterorum*, vol. ii, p. 266, pl. iii, fig. 28.
Polymorphanisus sexpunctata, Brauer, *Verh. Zool.-Bot. Ges. Wien*, vol. xviii, p. 263.
Æthaloptera ,, Ulmer, *Stett. Ent. Zeit.*, vol. lxvi, p. 50, pl. i, fig. 40.

There are several specimens from Rajshahi, E. Bengal (February, 1907), and one from Sara Ghat, R. Ganges, in the collection of the Indian Museum, the latter dated December 1st. I have given figures of venation and of male genitalia.

Gen. PHANOSTOMA.

Phanostoma sp.

(Pl. xiv, figs. 13—15.)

This is probably a new species, since this genus has heretofore not been reported from India or Asia. The two male specimens from Sara Ghat in the collection are considerably damaged and hardly admit of description. I am able, however, to give figures of venation and of genitalia.

Subfam. *HYDROPSYCHINÆ*.

Gen. HYDROPSYCHE.

Of this cosmopolitan genus four species have hitherto been reported from India and the East Indies. In the collection at hand there are two species, one of which is *Hydropsyche asiatica*, Ulmer, adequately described in *Stett. Ent. Zeit.*, vol. lxvi, p. 91, pl. iv, figs. 122—124. Of this species there are two males from Kurseong (*Annandale*, May, 1906). The other species is new.

Hydropsyche indica, sp. nov.

(Pl. xv, figs. 1—4.)

Length 9 mm. Expanse 18 mm. Head, prothorax and mesothorax covered with yellow hair. Antennæ yellow at base broadly ringed with black. Legs yellow with yellow and black hair. Fore wings brown, closely dotted with yellow, veins dark brown. Venation as usual in the genus; in the hind wing cell R_2 is very small and a median cross-vein is present (pl. xv, fig. 1). This species is distinctly smaller than *H. maligna*, Hag., and may be readily separated from the other three Indian species by the form of the genitalia (pl. xv, figs. 2, 4). In the

figure are shown two appendages of the penis, each consisting of a long membranous body, terminated by a strong chitinous hook. These appendages occur in all species of the genus I have observed, but they are not shown in figures of the genitalia heretofore published.[1] This is due to the fact that these appendages are generally retracted; they can be brought out easily by boiling in caustic soda. In this species these appendages are very long, reaching nearly to the end of the penis.

One male and one female from Kurseong (*Annandale*, May, 1906).

Gen. HYDROMANICUS.

This genus has been set apart from *Hydropsyche* mainly on two characters—the intermediate tarsi of the female are not dilated and the outer claws of the males are normal. The latter character I do not find of great value, for the claw may not be very abnormal in *Hydropsyche*. As defined, the genus *Hydromanicus* includes two groups which should in all likelihood constitute separate genera. One of these groups corresponds very closely to *Hydropsyche* except that the tibiæ of the female are not dilated. Judging from the specimens before me, further points of difference are that there are no appendages (Titillatoren) on the penis as in *Hydropsyche*. Furthermore, the base of the 2nd anal vein of the fore wing is in part obsolete, as is not the case in *Hydropsyche*. Regarding both these points observations on the other species of *Hydromanicus* are desirable. The second group, while it agrees with the former in not having the intermediate tibiæ of the female dilated, differs from it and from *Hydropsyche* in several points. The shape of the wings is decidedly different, the apex being markedly truncate. This difference is particularly striking when the wings are folded at rest. The jugum is well developed in the second group, while in the first, as in *Hydropsyche*, it is not so. The most striking venational difference is in the hind wings where Sc and R_1 both arch towards the sector in the region of cell 1st R_3 and then separate widely as they go to the wing-margin. In *Hydropsyche* and in its nearest allies in *Hydromanicus* Sc and R_1 have their tips fused (pl. xv, figs. 1, 5, 13).

Hydromanicus truncatus, sp. nov.

(Pl. xv, figs. 5—8.)

Length of body 8 mm. Expanse 17—19 mm. Head, prothorax, and mesothorax black with golden hair; metathorax brown, legs yellow, abdomen black. Antennæ black with an oblique white mark on each segment. Wings thickly covered with brownish black and with yellow hair, the yellow dots being distributed rather equally over the wings. Some of the light spots are in the wing membrane, as may be seen when the wing is denuded. Some

[1] Ulmer's latest figures are exceptions to this.

of these occur along the anterior margin, some along the posterior margin, particularly just before the tips of the anals, and a large patch of them is found at the wing apex. The shape of the claspers (Genitalfüssen) is very characteristic, the ends being truncate, at least as seen from above. The dark spots shown in pl. xv, fig. 8, are chitinized points on the dorsum of the ninth segment that can be distinguished only in specimens that have been cleared.

This species corresponds closely to the description of *H. luctuosus*, Ulmer. Some differences will be seen in the venation. The species agree, however, in having $\mathbf{R}_2$ and $\mathbf{R}_3$ of the fore wing fused further towards the wing-margin in the male than in the female. The two species are easily distinguished by the genitalia, the processes on the dorsal surface of the tenth segment being very slender in *truncatus*, and the ends of the claspers more or less truncate.

Several specimens from Kurseong (*Annandale*, May, 1906).

Hydromanicus dilatus, sp. nov.

(Pl. xv, figs. 9—12.)

Expanse 19-20 mm. Head and thorax dark brown with yellow hair. Antennæ yellow, narrowly ringed with brown, basal joint darker. Wings brown, with black and yellow hair, the yellow spots being distributed rather uniformly. The venation is of the type of *Hydropsyche* with no striking peculiarity except perhaps the transverse position of the tip of R_2 of the hind wing. The shape of the genitalia is characteristic, particularly that of the claspers. These have the first joint thickened distally, while the second joint is very long and slender.

One male and one female from Salatega, Java, sent by Dr. Zehntner.

The three species next to be described belong to that division of the genus characterized above as being more distantly related to *Hydropsyche*. Their nearest allies among described forms are donbtless *H. aspersus*, Ulmer, and *H. papilionaceus*, Hagen. With these they agree in having cell 1st R_3 of both wings long and narrow. They differ, judging from Ulmer's figures of *aspersus* and of *papilionaceus*, in having a cross-vein between Sc and $\mathbf{R}_1$ of the fore wing. Cell $\mathbf{R}_2$ of the hind wing is equal in length to its pedicel, not decidedly less as in *aspersus* nor decidedly more as in *papilionaceus*. The cross-vein between Cu_1 and Cu_2 of the fore wing is near the middle of the wing, a little before the cross-vein M-Cu. In the figure of *aspersus* it appears far towards the wing-margin and in *papilionaceus* it is apposed to the cross-vein M-Cu.

Hydromanicus marginatus, sp. nov.

(Pl. xv, fig. 13.)

Expanse 20 mm. Head black with black hair, thorax black above, golden towards the sides. Antennæ yellow at base, ringed

black, further out the proportions of the colours change so that the antennæ appear black, ringed yellow. Legs yellow to brown, with darker hair particularly on the distal joints; coxæ brown. On the fore wing the hairs on the anterior part are dark brown with spots of yellow particularly at the apex; the posterior third of the wing is almost wholly yellow and the veins in this region are more indistinct. The difference in coloration is very slightly indicated in the wing membrane.

Two females from Kurseong (*Annandale*, May, 1906).

Hydromanicus orientalis, sp. nov.

(Pl. xv, figs. 14—16.)

This species is closely related to *H. marginatus* but does not have the peculiar coloration of the latter and is considerably smaller, the expanse being 16 mm. The hair on the head is yellow, while in *marginatus* it is black. In the fore wing the membrane is nearly uniform brown, the pubescence rather scant, forming very indistinct irrorations of yellow and black. These irrorations are more distinct on the anterior margin. In venational and other characters, I see no difference between this and the preceding species.

[Specimens from Kurseong (*Annandale*, May, 1906).]

Hydromanicus brunneus, sp. nov.

(Pl. xvi, figs. 1—4.)

Length to tip of the wings 8 mm. Head and thorax dark brown to black above with brown hair. Antennæ at base whitish ringed with brown; more distally the brown band is wider than the pale one. Legs dark brown, tarsi still darker; hind femora with long hair. Fore wings reddish brown with lighter spots particularly along the anterior margin and at apex. The alternate light and dark markings at the wing apex extend also over the marginal fringe. Venation practically as in the two preceding species. Genitalia very different from the preceding species as shown by the figures.

Several specimens from Upper Assam.

Fam. POLYCENTROPIDÆ.

Subfam. *POLYCENTROPINÆ.*

Gen. HYALOPSYCHODES, nov.

This genus is closely related to *Hyalopsyche*, Ulmer, reported from W. Africa. It differs from that genus mainly in having no labial palpi. The maxillary palpi are like those figured by Ulmer for *Hyalopsyche*, but the fifth joint is comparatively longer. In addition it may be noted that the disparity of length in the spurs

is more striking on the first pair of legs than on the second and third pairs as described for *Hyalopsyche.* This is the first genus described as having maxillary palpi but no labial palpi.

Hyalopsychodes rivalis, sp. nov.

(Pl. xvi, figs. 5—7.)

Length 10 mm. Expanse 20 mm. Head, prothorax, and mesothorax dark brown, metathorax yellow. Wings brown. Head, thorax and wings covered with short yellowish hair. Antennæ with globose basal joint, the others longer; the joints near the base are thicker than those at the tip and have dark brown bands near their distal ends. Legs yellow. The venation is strikingly similar to that of *Hyalopsyche palpata*, Ulmer. The abdomen of the female is modified into an ovipositor as in *Hyalopsyche.*

The specimens at hand are females taken at Rajshahi, Eastern Bengal, 1—6-ii-07 (*Annandale*).

Gen. DIPSEUDOPSIS.

(Pl. xvi, figs. 8—13.)

The species of this genus have been differentiated mainly on the form of the abnormal spur on the hind tibiæ of the male. In this collection there are four specimens of a species of this genus but they are all in bad condition. I add figures of venation, the palpi, genitalia, and of the abnormal spur. The spur is unlike any I have seen figured.

Fam. CALAMOCERATIDÆ.

Gen. GANONEMA.

Ganonema brunneum.

Ganonema brunneum, Ulmer, *Stett. Ent. Zeit.*, vol. lxvi, p. 31, pl. i, fig. 26.

Of this species there is one female specimen from Sibsagar, Assam.

Ganonema salsum, sp. nov.

(Pl. xvi, figs. 14—17.)

Length to tip of wings 9-10 mm. Expanse 21 mm. Almost wholly brownish yellow, with hair of the same colour. Basal joint of antenna thick, second very small, the third longest, the succeeding ones about equal to the first. Palpi hairy, the proportions of the segments as figured (pl. xvi, fig. 17). By Ulmer's key to the genus (*Notes from the Leyden Museum*, vol. xxviii, p. 50) this species runs to *G. brevipenne*, Ulmer. The description also agrees fairly well but there appear to be decided differences in venation and in

the genitalia. The following points in the venation may be noted as different from those in *G. brevipenne*. The cross-vein RM is at the apex of cell M_1 and does not touch cell R_1; cell M_3 reaches back on cell 1st M for two-thirds the length of the latter. The venation of the hind wing seems to be like that of *brevipenne* although the shape is not the same.

Several specimens from Upper Assam.

Gen. ASOTOCERUS.

Asotocerus fuscipennis.

(Pl. xvii, figs. 1—3.)

Asotocerus fuscipennis, Albarda, Veth's *Midden-Sumatra*, vol. iv, pt. 5, p. 17, pl. v, fig. 1.

Figures of the venation and of the male genitalia are here given. The venation differs from Albarda's figure mainly in the presence of the cross-vein Cu_{1a} to Cu and the cross-vein between Sc and R_1 of the fore wing. The latter is very distinctly indicated. In the hind wing also there is a cross-vein between Sc and R_1.

[Specimens from Kulu, W. Himalayas.]

Fam. ODONTOCERIDÆ.

Gen. MARILIA.

Of this family no species have yet been reported from India. In this collection there is a single specimen, too poorly preserved to admit of description, which I regard as a species of *Marilia*, in spite of the fact that it differs from other species of that genus in not having R_1 and R_2 of the fore wing fused. As in females of other species of this genus, the spur formula is 2-4-4 and the hind wings are narrow. The venation of the fore wing is somewhat more generalized than those of this genus hitherto published, but these latter are probably of males (pl. xvii, fig. 4).

The spec'men is from Bhim Tal, Kumaon, 4,500 ft., 22—27-ix-06 (*Annandale*).

Fam. LEPTOCERIDÆ.

Subfam. *TRIPLECTIDINÆ*.

Gen. NOTANATOLICA.

Notanatolica magna.

Notanatolica magna, Walker, *Cat. Neur. Bri'. Mus.*, p. 73.
,, ,, McLachlan, *Trans. Ent. Soc. Lond.* (3), vol. v, p. 257, pl. xix, fig. 3.
,, ,, Ulmer, *Notes from the Leyden Museum*, vol. xxviii, p. 32.

Of this species there are two female specimens from Calcutta

Notanatolica opposita (?).

(Pl. xvii, figs. 5—8.)

Notanatolica opposita, Walker, *Cat. Neur. Brit. Mus.*, p. 73.
,, ,, McLachlan, *Trans. Ent. Soc. Lond.* (3), vol. v, pp. 257, 258.
,, ,, Ulmer, *Notes from the Leyden Museum*, vol. xxviii, p. 32.

There are two male specimens of what I take to be this species. Doubt is cast on this determination by the fact that while R_2 and R_3 of the hind wing are fused, the cell 1st R_3 of the fore wing is not of the shape described for the female of this species by Ulmer. Nor do the cross-veins connecting that cell occupy the positions indicated by him. I add figures of the genitalia.

[One specimen from Calcutta (*Alcock*).]

Subfam. *LEPTOCERINÆ*.

Gen. SETODES.

Setodes argentifera.

(Pl. xvii, figs. 9—11.)

Setodes argentifera, McLachlan, *Journ. Linn. Soc. Lond.*, Zool., vol. xi, p. 129, pl. iii, figs. 13, 13*a*.

This pretty little species is easily recognized from McLachlan's description. I add figures of venation and of genitalia because they differ somewhat from those of McLachlan's paper. In the venation the chief point of difference is that I find the radial cross-vein of the hind wing running to Sc and R_1 rather than to the wing-margin. In the drawings of the genitalia there is considerable difference. McLachlan has failed to show the bristly two-pronged appendage which appears to be an upper branch of the clasper. The slender spines referred to by McLachlan I suppose are those running close alongside of the strongly curved penis.

Fam. SERICOSTOMATIDÆ.

Subfam. *GOERINÆ*.

Gen. GOERA.

Of this genus there appear to be at least three species, represented by material in very bad condition. But one of these species is here described.

Goera relicta, sp. nov.

(Pl. xviii, figs. 1—5.)

Expanse about 13 mm. Distinguished from other species mainly by the venation and the genitalia. In the fore wing R_2

and R_3 separate before the middle of cell 1st R_8, not beyond it as in *G. pilosa.* In the hind wing cell R_2 is decidedly shorter than cell R^4, not longer as in *G. longispina*; there is no cross-vein R_2-R_3 as in *G. conclusa.* On the sixth ventral segment there is a single blunt elongate tooth with no spines alongside of it as there are in *G. pilosa* and *G. japonica.* This tooth is about one half as long as the segment. The male palpi are difficult to make out satisfactorily. The basal joint is short, one-and-a-half times as long as wide; the second is apparently wider than long; the third is about as long as the first and second. It is densely covered with very small club-shaped striate scale hairs.

Subfam. *LEPIDOSTOMATINÆ.*

Gen. GOERODES.

Goerodes sp.

(Pl. xviii, figs. 6—9.)

The three specimens belonging to this species are all females hardly admitting of specific determination. Ulmer's description of *G. cornigera* and his notes on *G. vulpina*, Hag., and *G. ursina*, Hag., seem to exclude these as possible determinations for this species. The figures and notes here added may make later determination of this material possible.

Length to tip of wings 7 mm. Expanse 13 mm. First joint of antennæ covered with long yellow and fewer black hairs, succeeding joints darker at their distal ends. Legs yellow with dark hair, particularly externally. Spurs 2-4-4, subapical spurs of intermediate tibiæ three-eighths the way from the proximal end, those of the hind tibiæ three-fourths the way; hind tibiæ somewhat curved in the region of the subapical spurs. Wings light brownish with short yellow and longer black hair. The venation differs from that of *G. vulpina* figured by Ulmer (*Cat. Coll. Sélys.*, fasc. 6, p. 40, fig. 64) mainly in that cell Cu_{1a} does not extend as far back as cell 1st R , and that Cu is not arched strongly near its branching; in the hind wing Sc and R are fused beyond the apex of cell R_2, there is no cross-vein R_3-R_4, cell M_2 does not extend further back than cell R .

Three specimens from Upper Assam.

Gen. DINARTHRELLA.

Dinarthrella sp.

(Pl. xviii, figs. 10—12.)

There are two specimens (♂ and ♀) of *Dinarthrella* doubtless representing a new species but in such very bad condition that I do not propose a specific name and content myself with giving figures of venation, the first joint of the antennæ, and the genitalia

of the male. *D. destructa*, Ulmer, is apparently a close ally but the genitalia and the first antennal joint are different.

Specimens from Kurseong, May, 1907 (*N. Annandale*).

Fam. PHRYGANEIDÆ.

Gen. NEURONIA.

Three species of this genus are reported from Asia: *N. melaleuca* and *N. regina* from Japan and *N. maclachlani* from India. Of the latter there are a female and male specimens in this collection. There is besides a male specimen of a new species.

Neuronia maclachlani.

(Pl. xviii, figs. 13, 14.)

Neuronia McLachlani, White, *Proc. Ent. Soc. Lond.*, 1862, p. 26.
,, ,, McLachlan, *Trans. Ent. Soc. Lond.* (3), vol. v, p. 249, pl. xvii, fig. 1.
,, ,, Hagen, *Verh. Zool.-Bot. Gesellsch. Wien*, 1873, p. 395.

[Specimens from Kulu (W. Himalayas), Darjiling (E. Himalayas) and Shillong (Khasi Hills, Assam).]

Neuronia asiatica, sp. nov.

(Pl. xviii, figs. 15, 16.)

Length of body 15 mm. Expanse 41 mm.

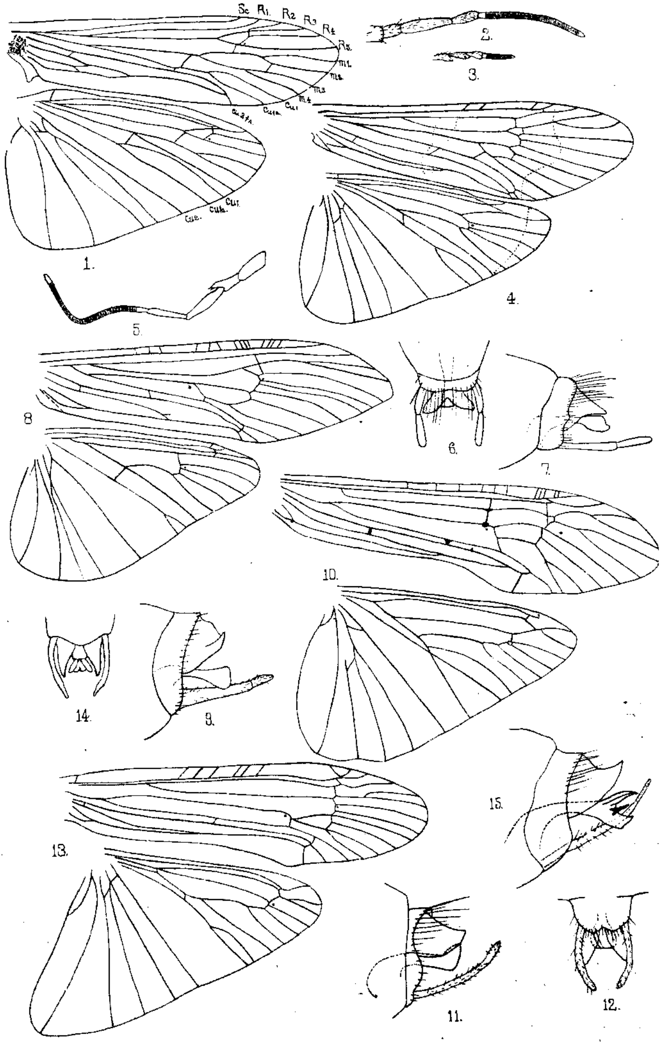
Head and thorax dark brown, eyes black, ocelli yellow. Fore wings orange with brown spots, the largest spots along the costa and apical margins, covering the tips of the veins, a particularly large spot on the tip of Sc ; there is an irregular brown band following the line of anastomosis from the first branching of media to the tip of the anal veins. The hind wing has the basal two-thirds dark brown; the distal third is yellow. There is an interrupted apical band of brown, the brown spots being on and along the tips of the veins. The abnormality of venation shown in the anal veins of the hind wing occurs in both wings of the specimen.

[Type from Sibsagar, Assam (*S. E. Peal*).]

EXPLANATION OF PLATE XIV.

MACRONEMATINÆ.

FIG.	1.—Wings of	*Stenopsyche*	*griseipennis*, McL.			
,,	2.—Max. palpus of	,,	,,			
,,	3.—Labial	,,	,,	,,		
,,	4.—Wings of	*Macronema*	*fastosum*, Walker.			
,,	5.—Max. palpus of	,,	,,			
,,	6.—Genitalia of	,,	,,	♂	(dorsal view).	
,,	7.—	,,	,,	,,	♂	(lateral view).
,,	8.—Wings of	*Polymorphanisus*	*nigricornis*, Walker.			
,,	9.—Genitalia of	,,	,,	♂	(lateral view).	
,,	10.—Wings of	*Æthaloptera*	*sexpuncta*, Kol.			
,,	11.—Genitalia of	,,	,,	♂	(lateral view).	
,,	12.—	,,	,,	,,	♂	(dorsal view).
,,	13.—Wings of	*Phanostoma* sp.				
,,	14.—Genitalia of	,,	,,	(dorsal view).		
,,	15.—	,,	,,	,,	(lateral view).	


Sc
R1.
R2
R3
R4
R5.
m1.
m2.
m3
m4
Cu1
Cu1a.
Cu2+A.
Cu1.
Cu1b.
Cu2.
1.
2.
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5.
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9.
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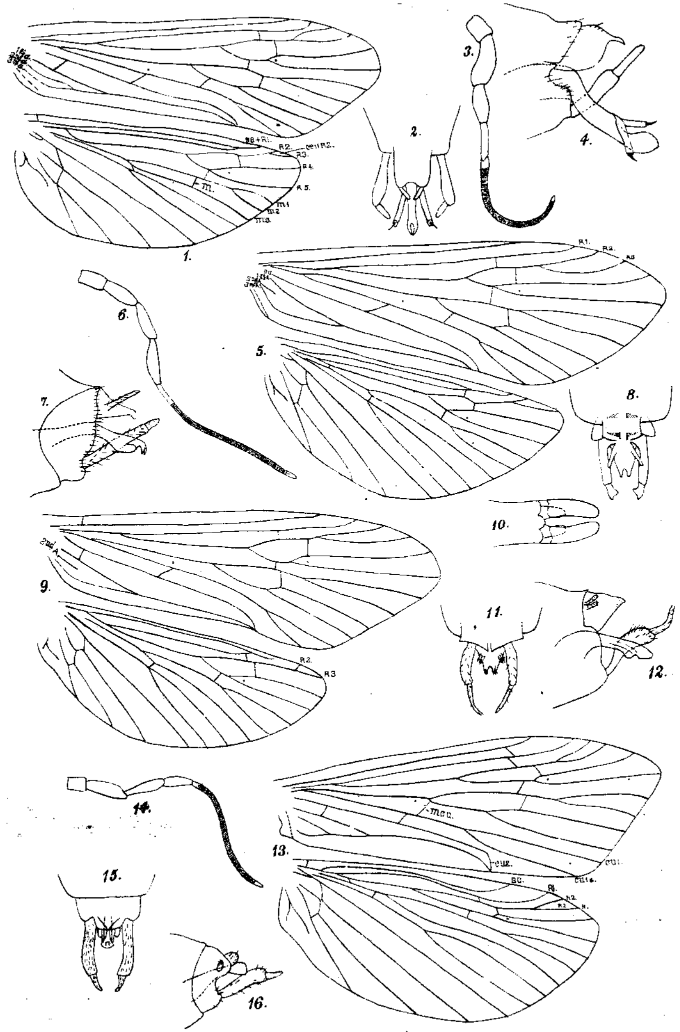
EXPLANATION OF PLATE XV.

HYDROPSYCHINÆ.

FIG. 1.—Wings of	*Hydropsyche*	*indica*, sp. nov.		
,, 2.—Genitalia of	,,	,,	♂	(dorsal view).
,, 3.—Max. palpus of	,,	,,		
,, 4.—Genitalia of	,,	,,	♂	(lateral view).
,, 5.—Wings of	*Hydromanicus*	*truncatus*, sp. nov.		
,, 6.—Max. palpus of	,,	,,		
,, 7.—Genitalia of	,,	,,	♂	(lateral view).
,, 8.— ,,	,,	,,	♂	(dorsal view).
,, 9.—Wings of	,,	*dilatus*, sp. nov.		
,, 10.—Penis of	,,	,,		(ventral view).
,, 11.—Genitalia of	,,	,,	♂	(dorsal view).
,, 12.— ,,	,,	,,	♂	(lateral view).
,, 13.—Wings of	,,	*marginatus*, sp. nov.		
,, 14.—Max. palpus of	,,	*orientalis*, sp. nov.		
,, 15.—Genitalia of	,,	,,	♂	(dorsal view).
,, 16.— ,,	,,	,,	♂	(lateral view).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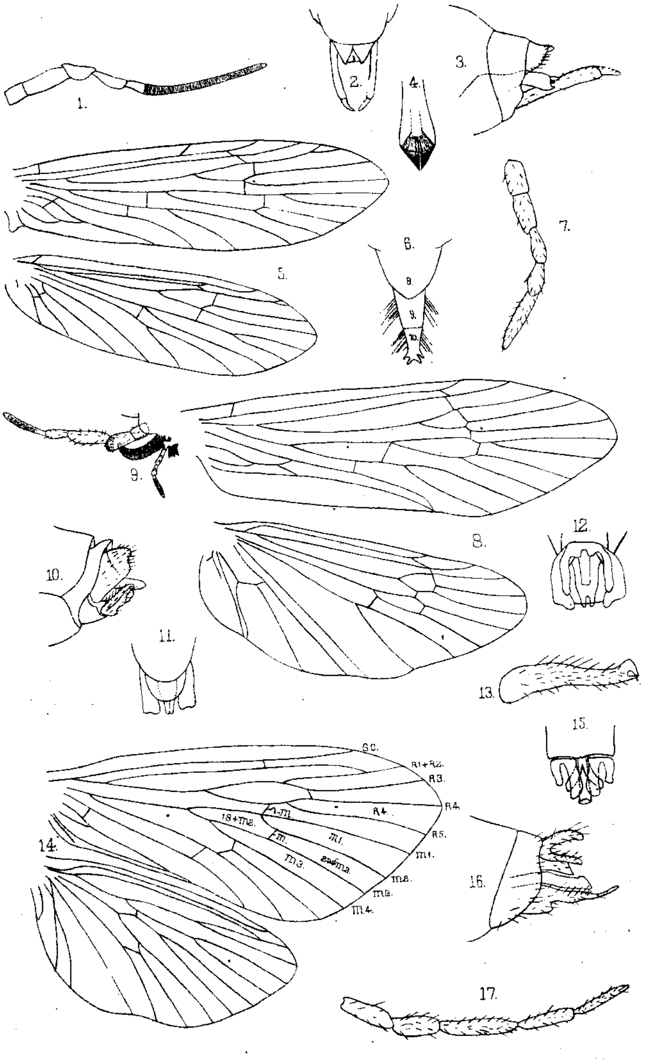
16.
R2.
R3.
R4.
R5.
m.
m1
m2
m3.
R1.
2nd A.
mcu.
cu2.
cu1.
sc.

EXPLANATION OF PLATE XVI.

HYDROPSYCHINÆ, POLYCENTROPIDÆ and CALAMOCERATIDÆ.

FIG. 1.—Max. palpus of *Hydromanicus brunneus*, sp. nov.
,, 2.—Genitalia of ,, ,, ♂ (dorsal view)
,, 3.— ,, ,, ,, ♂ (lateral view).
,, 4.—Penis of ,, ,,
,, 5.—Wings of *Hyalopsychodes rivalis*, sp. nov.
,, 6.—Ovipositor of ,, ,,
,, 7.—Max. palpus of ,, ,,
,, 8.—Wings of *Dipseudopsis* sp.
,, 9.—Mouth parts of ,, ,,
,, 10.—Genitalia of ,, ,, ♂ (lateral view).
,, 11.— ,, ,, ,, (dorsal view).
,, 12.— ,, ,, ,, (ventral view).
,, 13.—Abnormal spur of ,, ,,
,, 14.—Wings of *Ganonema salsum*, sp. nov.
,, 15.—Genitalia of ,, ,, ♂ (dorsal view).
,, 16.— ,, ,, ,, (lateral view).
,, 17.—Max. palpus of ,, ,,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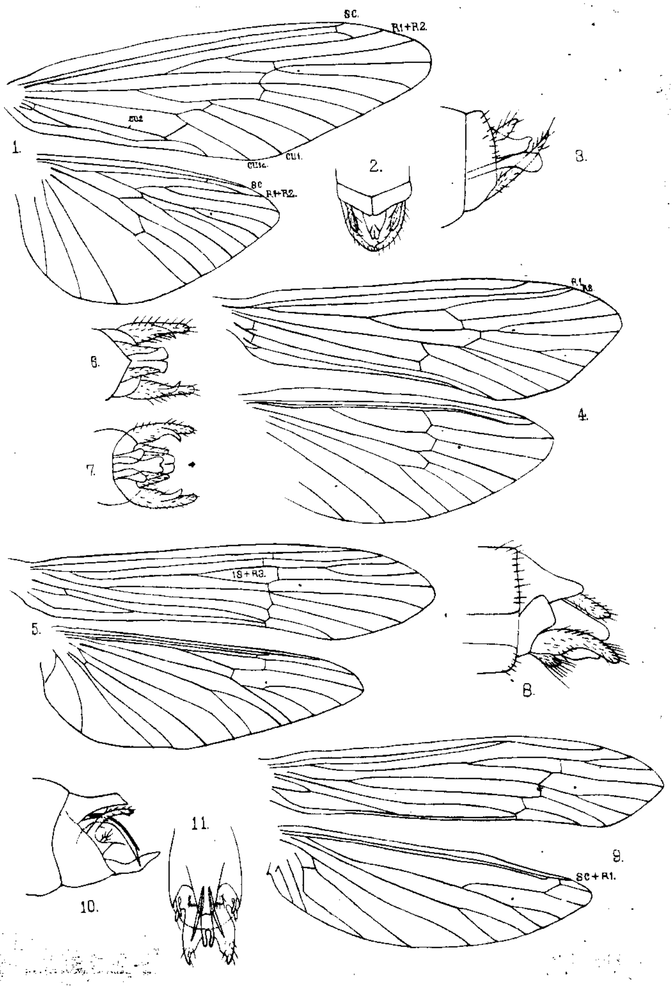
14.
15.
16.
17.
Sc.
R1+R2.
R3.
R4.
R4.
R5.
m1.
m1.
m2.
m3.
m3.
m4.

EXPLANATION OF PLATE XVII.

CALAMOCERATIDÆ, ODONTOCERIDÆ and LEPTOCERIDÆ.

FIG. 1.—Wings of *Asotocerus fuscipennis*, Albarda.					
,, 2.—Genitalia of	,,	,,	♂	(dorsal view).
,, 3.—	,,	,,	,,		(lateral view).
,, 4.—Wings of *Marilia* sp.					
,, 5.—Wings of *Notanatolica opposita* (?), Walker.					
,, 6.—Genitalia of	,,	,,		(dorsal view).
,, 7.—	,,	,,	,,		(ventral view).
,, 8.—	,,	,,	,,		(lateral view).
,, 9.—Wings of *Setodes argentifera*, McL.					
,, 10.—Genitalia of	,,	,,	♂	(lateral view).
,, 11.—	,,	,,	,,		(ventral view, with tip of abdomen tilted upwards).

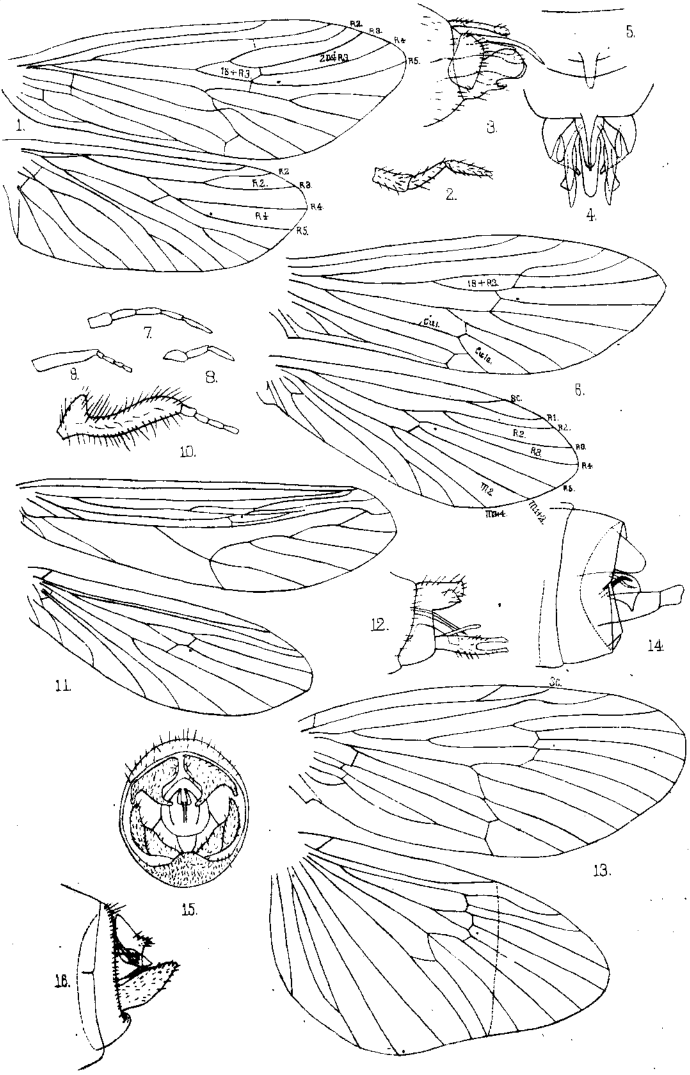
Plate XVII.



EXPLANATION OF PLATE XVIII.

SERICOSTOMATIDÆ and PHRYGANEIDÆ

FIG. 1.—Wings of *Goera relicta*, sp. nov.
,, 2.—Labial palpus of *Goera relicta*.
,, 3.—Genitalia of ,, ,, ♂ (lateral view).
,, 4.— ,, ,, ,, ♂ (dorsal view).
,, 5.—Tooth on 6th ventral segment of *Goera relicta*, ♀.
,, 6.—Wings of *Goerodes* sp.
,, 7.—Max. palpus of *Goerodes* sp., ♀.
,, 8.—Labial ,, ,, ,, ,, ♀.
,, 9.—Basal part of antenna of *Goerodes* sp.
,, 10.— ,, ,, ,, ,, ,, *Dinarthrella* sp., ♂.
,, 11.—Wings of *Dinarthrella* sp., ♂
,, 12.—Genitalia of ,, ,, ♂ (lateral view).
,, 13.—Wings of *Neuronia asiatica*, sp. nov.
,, 14.—Genitalia of ,, ,, (lateral view).
,, 15.— ,, ,, *maclachlani*, White (end view).
,, 16.— ,, ,, ,, (lateral view).



1.
R2.
R3.
R4.
R5.
2nd R3
1st + R3
2.
3.
4.
5.
R2
R2.
R3.
R4.
R4.
R5.
6.
1st + R2
Cu1.
Cu1a.
Sc.
R1.
R2.
R2.
R3.
R3.
R4.
R5.
m2
m3+4.
m1+2.
7.
8.
9.
10.
11.
12.
13.
Sc.
14.
15.
16.

XV. DIAGNOSES OF NEW SPECIES AND VARIETIES OF FRESHWATER CRABS. Nos. 1—3.

By A. Alcock, *F.R.S.*

No. 1.

In examining the Indian Museum collection of freshwater crabs (Potamonidæ) I have, so far, met with the following species and varieties of the subgenus *Potamon* that seem to be " new " :—

1. *Potamon (Potamon) fluviatile*, Latreille, var. *gedrosianum*.

This variety agrees with the variety *ibericum* in all but the following particulars:—(*a*) The carapace is broader, its length in large adults seldom exceeding $\frac{13}{18}$ths of its breadth, owing to the greater convexity of the antero-lateral borders; (*b*) the cervical groove is deep-cut in all its course; (*c*) the epigastric crests are more tumid and more in advance of the post-orbital crests. It occurs in Baluchistán, Seistán, and the Salt Range of the Punjáb.

2. *Potamon (Potamon) atkinsonianum*, Wood-Mason, var. *emphyseteum*.

This variety agrees with Wood-Mason's type in all but the following particulars :—(*a*) The antero-lateral borders of the carapace are very strongly convex, this adds to the breadth of the carapace and makes the postero-lateral borders remarkably convergent, it also makes the ripple-like tubercles of the antero-lateral part of the epibranchial regions more oblique; (*b*) the sixth abdominal segment of the adult male is always two-thirds as long as broad, whereas in a series of *atkinsonianum* it is a variable amount less than two-thirds. It occurs in the Punjáb Himalayas, at Bilaspur and Kangra.

3. *Potamon (Potamon) atkinsonianum*, Wood-Mason, var. *ambivium*.

This small variety is annectant between *atkinsonianum* and Miss Rathbun's species, or variety, *koolooense*. Like the latter form it is small, the carapace of an egg-laden female being less than an inch long. It occurs at Dharampur, near Simla, 5,000 feet elevation.

4. *Potamon* (*Potamon*) *atkinsonianum*, Wood-Mason, var. *ventriosum*.

This variety agrees in every respect with Wood-Mason's type, except in the form of the male abdomen, which is broad, the sixth segment being twice as broad as long. It is represented by a single specimen, a large male with a carapace nearly two inches broad, from Kumáon, about 6,000 feet elevation. It is possibly an aberrant individual, not a "variety" in the strict sense of the term—if terms were always used in their strict sense.

5. *Potamon* (*Potamon*) *bifarium*, sp. nov.

Belongs to the *atkinsonianum* clan, and is distinguished from *atkinsonianum* by the following characters:—(*a*) The carapace is distinctly convex behind the frontal slope; (*b*) the epibranchial areolæ are less distinct; (*c*) the abdomen of the adult male is broader, the sixth segment varying in length from almost half to two-thirds the greatest breadth; (*d*) the legs are slenderer, for instance, in the second and third legs the propodite is two-and a-half times as long as broad. The species is represented by six males collected by Dr. W. T. Blanford either in Sikhim or in Burma.

6. *Potamon* (*Potamon*) *andersonianum*, Wood-Mason, var. *asperatum*.

Only differs from the type in having the entire carapace very finely granulous. The specimens are young and the character specified is variable. They come from Ganjam in the Cachar Hills, about 4,000 feet elevation,—not from Ganjam on the East Coast.

7. *Potamon* (*Potamon*) *andersonianum*, Wood-Mason, var. *manipurense*.

In this variety the surface sculpture of the carapace has a "worn" look, and the edge of the front is a little sinuous. A male and a female from the Manipur Hills.

8. *Potamon* (*Potamon*) *andersonianum*, Wood-Mason, var. *tritum*.

In this variety the surface sculpture is still more worn-looking, and the edge of the front is so sinuous as to suggest four faint lobes. A single female from the Kakhyen Hills, Upper Burma; in Dr. J. Anderson's Yunnan collection.

9. *Potamon* (*Potamon*) *edwardsi*, Wood-Mason, var. *hirtum*.

In this variety the tufts of bristly setæ on the dorsum of the carapace may be so numerous as to give the specimen a harsh woolly feel, and the legs are rather thickly hirsute. The pustule-like tubercles of the upper surface of the palm may be more

numerous and a little smaller. Nine males and three females from the Kakhyen Hills and Yunnan; in Dr. Anderson's Yunnan collection.

10. *Potamon* (*Potamon*) *pealianum*, Wood-Mason, var. *antennarium*.

In this "variety"—using the term without any definite implication—the antennular fossæ are wide fore and aft owing to an overgrowth of the epistomial portion of the inter-antennular septum. In consequence of this pushing up of the edge of the front the antennal peduncles stand quite clear of the front, being neither in contact with nor overlapped by the front. I find this abnormality in four old females only, two of them from Sibsagar, Assam, two from an unrecorded locality.

11. *Potamon* (*Potamon*) ***turgidulum***, sp. nov.

Belongs to the *pealianum* and *tumidum* clan. Resembles *P. tumidum*, Wood-Mason, in form and size, but differs as follows:—(*a*) The grooves of the carapace are more superficial; (*b*) the front—in individuals of equal size—is narrower, and its edge is distinctly bilobed; (*c*) the edge of the post-orbital crests is thin and well defined, *not* thick and somewhat confused with the rugosities of the carapace as it is in *tumidum*; (*d*) the merus of the external maxillipeds is as long as broad; (*e*) the legs are longer—in individuals of equal growth—the second (longest) pair being considerably longer than the chelipeds. Eleven males and six females (one with eggs) from Burma. The length of the carapace in adults is less than an inch.

12. *Potamon* (*Potamon*) ***tumidulum***, sp. nov.

Very close to *tumidum* and *turgidulum*, but the carapace is less convex, and the post-orbital crests are very rugose and blunt-edged. Though not so convex dorsally the carapace is hardly less deep, its depth being half its length. The front is less than a third the greatest breadth of the carapace in adults—in *turgidulum* it is a third, in *tumidum* more than a third. The chelipeds are more unequal, and they and the legs are somewhat hirsute. Eight males, eight females, and eight young from Pharping, Nepal. In the largest specimen (a mature female) the carapace is only $\frac{3}{4}$ths of an inch long. This species could not be placed in the *Geotelphusa* group as its post-orbital crests, though blunt-edged, are tumid and bold.

13. *Potamon* (*Potamon*) ***simulum***, sp. nov.

Very close to *P. austenianum*, Wood-Mason, and having the same remarkably long, slender legs, but differing in the following particulars:—(*a*) The carapace is shorter and wider, and its areolation is much less distinct; (*b*) the front is much narrower—not

one-fourth the greatest breadth of the carapace—and is vertically deflexed.

A single female, with a carapace nearly 2 inches broad, from Burma.

14. *Potamon (Potamon) pruinosum*, sp. nov.

Belongs to the *P. larnaudii* clan, but differs from this and all other related species in the profusely tuberculous carapace. The carapace is deep—its depth equals half its length—and its grooves are very faint. The cervical groove does not cut the post-orbital crests. The surface of the frontal and of the anterior half of the gastric and epibranchial regions is covered with pearly granules and transverse dentiform tubercles of a brilliant whitish colour. Smaller pearly white granules stud the chelipeds. The edge of the epigastric and post-orbital crests is broken into long transverse and oblique whitish imbricating tubercles. Its nearest relative is *P. brevimarginatum*, de Man; but it is more profusely and crisply and finely tuberculous than that species; has a deeper carapace; and, except for a very superficial and incomplete cervical groove, has no distinct areolation of the dorsum.

Locality.—Hills between Burma and Siam.

No. 2.

POTAMISCUS, gen. nov.

Potamiscus in one particular (namely, the absence of a flagellum from the exopodite of the external maxillipeds) resembles *Pseudotelphusa*; but it has no other affinities with that genus. Its closest relations are with the *Potamon fluviatile* group, as it has a simple mandibular palp—*i.e.*, a mandibular palp with the terminal joint not bifurcate—such as is found in *P. fluviatile*, *P. atkinsonianum*, *P. kooloocnse*, *P. andersonianum*, *P. edwardsi*, *P. hispidum*, *P. bifarium*, *P. pealianum*, *P. tumidum*, *P. turgidulum*, *P. tumidulum*, *P. austenianum*, *P. simulum*, *P. larnaudii*, *P. manii*, *P. brevimarginatum*, *P. stoliczkanum*, *P. thagatense*, *P. (Geotelphusa) sikkimense*, and *not* in any other Indian species. The value of the mandibular palp in classifying the Potamonidæ has lately been disclosed by Dr. W. T. Calman.

1. *Potamiscus annandalii*, sp. nov.

This species has a very strong superficial resemblance to *P. pealianum*, from which it is easily distinguished by the following characters:—

(1) the flagellum of the exopodite of the external maxillipeds is either quite vestigial or altogether wanting;

(2) the cervical groove is distinguishable only in the middle of the carapace, where it bounds the mesogastric areola posteriorly;

(3) the post-frontal and post-orbital crests form a continuous wavy curve from the middle line to the lateral epibranchial tooth,

as in the mixed assemblage of species to which the name *Potamonautes* has been applied.

In a large female the carapace is 1 inch long, 1½ inch broad, and a little over ½ an inch deep.

From Nemotha, Cachar; nine males and six females.

2. Varieties of *Potamon lugubre*, Wood-Mason.

This species is not a true *Potamon* (subgenus), since it has the terminal joint of the mandibular palp bifurcate or bilobed as in "*Potamonautes*" *jacquemontii*, "*Geotelphusa*" *lævis*, *Paratelphusa spinigera* and *Gecarcinucus jacquemontii.*

It is a very variable species. In the large series which I have examined I can distinguish five varieties (not including *P. masonianum* which seems to be but a variety) to some or all of which many naturalists, with only single specimens of each before them, might give specific rank. In none of these varieties, however, is there any constancy.

a. Potamon lugubre, var. ***edentulum.***

In this variety the lateral epibranchial tooth is quite obsolete, the antero-lateral borders of the carapace are unusually convex, and the individual regions of the carapace are unusually tumid.

From the Naga Hills.

b. Potamon lugubre, var. ***harpax.***

Though the carapace is flat on the whole, the individual regions are tumid, the amount of swelling being very variable: the carapace also is not quite so broad as in the type.

The lateral epibranchial tooth is usually more distinct, and the antero-lateral borders are often less arched than in the type.

The front is usually less deflexed.

The spine at the inner angle of the carpus is usually more acute.

In *some* large males the hand of the larger cheliped is enormously enlarged, the dactylus being much longer than the palm and strongly arched, so that when the fingers are closed only their tips are in contact and a very wide gap is left between them. In the female the fingers of both chelipeds are usually a little longer than in the type.

From Assam, Cachar, Sylhet, Khasi Hills, Garo Hills, and Naga Hills.

c. Potamon lugubre, var. ***nigerrimum.***

As in the variety ***harpax*** the carapace is not quite so broad, the lateral epibranchial tooth is a spine, the individual regions of the carapace are tumid, the antero-lateral borders are less arched, and the front is less deflexed.

The colour is greenish-black to coal-black.
From North Lushai.

d. Potamon lugubre, var. *plautum.*

In comparison with the typical form of *P. lugubre*:—

The carapace is not quite so broad, and is unusually flat.

The lateral epibranchial tooth is usually more prominent, as in the variety *harpax.*

The front is less deflexed and the epigastric crests are more oblique.

The wings of the cervical groove are unusually broad.

The 6th abdominal segment of the male is slightly broader.

From Assam and the Khasi Hills.

e. Potamon lugubre, var. *falcidigitus.*

As in the three preceding varieties the carapace is not quite so broad and the front is less deflexed.

As in the variety *plautum* the carapace, in most individuals, is uncommonly flat, and the wings of the cervical groove are unusually broad.

As in typical *lugubre*, the lateral epibranchial tooth is small, indistinct, or obsolescent.

The chelipeds have the fingers remarkably broadened, so that although the upper border of the dactylus is quite as strongly curved as it is in typical *lugubre*, yet the fingers when closed are in contact, or almost so, along the whole extent of their cutting edge; but the breadth of the fingers is variable. Sometimes there is a row of two or three spines or large bead-like granules on the proximal end of the upper surface of the dactylus.

In all the legs the edges of the propodite are very strongly serrated, and the anterior edge of the carpus is also strongly serrated.

From Cachar, Cherra Punji, Khasi Hills, Garo Hills, and Naga Hills.

3. *Potamon napæum*, sp. nov.

The species differs from *P. lugubre* and *P. masonianum* (if this latter is anything more than a variety of the former) in the following characters, which are constant in five males and six females:—

The carapace has an oval outline, and the antero-lateral borders are well defined, slightly raised, and regularly beaded or crenulate.

There is no trace of a lateral epibranchial tooth, the antero-lateral borders at that point being in unbroken continuity with the post-orbital crests.

The sub-orbital lobes of the carapace are quite distinctly defined.

From Ganjam in North Cachar, 4,000 feet.

No. 3.

The Potamonidæ of the Indian fauna are included in three principal genera, *Potamon*, *Paratelphusa*, and *Gecarcinucus*.

In the genus *Potamon* the terminal joint of the mandibular palp is simple; the 6th segment of the abdomen of the adult male is short and broad, its length never being equal to its distal (least) breadth; and the cervical groove, when it is distinct, runs towards the external orbital tooth on either side.

In the genus *Paratelphusa* the terminal joint of the mandibular palp is bilobed, the anterior lobe (which is broadly oval) overhanging the ventral surface of the mandible, the posterior lobe (which is falciform) lying behind the incisor process; the 6th segment of the abdomen of the adult male is a longish joint, its length hardly ever being less, and usually being more, than its distal breadth; and the cervical groove when distinct usually runs towards the lateral epibranchial tooth on either side.

In the genus *Gecarcinucus* the terminal joint of the mandibular palp is bifurcate as in *Paratelphusa*; the 6th segment of the abdomen of the adult male is broad as in *Potamon*, but is narrowed distally in a way of its own; and the front is particularly narrow in the adult.

The Indian species of the genus *Potamon* can be grouped in four maniples or subgenera as follows:—

1. Subgenus *Potamon*. The antero-lateral borders of the carapace are crenulate or serrulate, not multispinous: there is no spine at the far end of the upper border of the merus of the chelipeds: the exopodite of the external maxillipeds carries a strong plumose flagellum: the post-orbital crests and lateral epibranchial spine of the carapace are well developed.—Type *Potamon fluviatile*, Latr.

2. Subgenus *Geotelphusa*. As *Potamon*, but the post-orbital crests and lateral epibranchial spine are ill-developed or obsolete.—Type *G. obtusipes*, Stimpson.

3. Subgenus *Potamiscus*. As *Potamon*, but the flagellum of the exopodite of the external maxillipeds is absent or vestigial.—Type *P. annandalii*, A. A.

4. Subgenus *Paratelphusula*, nov. As *Potamon*, but the antero-lateral borders of the carapace are cut into large teeth or spines, and there is a strong subterminal spine on the upper border of the merus of the chelipeds.—Type *P. dayana* (W.-M.).

[*N.B.*—The species of this subgenus of *Potamon* have been confused with *Paratelphusa* (type *P. tridentata*) which is a widely different form.]

The Indian species of the genus *Paratelphusa* can be grouped in six subgenera, as follows:—

1. Subgenus *Paratelphusa*. The antero-lateral borders of the carapace are usually cut into large teeth or spines, and there is always a strong subterminal spine on the upper border of the

merus of the chelipeds: the exopodite of the external maxillipeds carries a strong plumose flagellum.—Type *P. tridentata*, A. M.-Edw.

2. Subgenus *Leschenaultia*, nov. The antero-lateral borders of the carapace are *not* spinose: there is *no* subterminal spine on the upper border of the merus of the chelipeds: the epigastric crests of the carapace are in advance of and quite independent of the post-orbital crests: the exopodite of the external maxillipeds carries a strong plumose flagellum.—Type *L. hydrodromus* (Herbst).

3. Subgenus *Phricotelphusa*, nov. As *Leschenaultia*, but the flagellum of the exopodite of the external maxillipeds is either absent, or vestigial, or filamentous, or is inconstant in one and the same species; and the antennal flagellum is minute or vestigial.—Type *P. callianira* (de Man).

4. Subgenus *Barytelphusa*, nov. As *Leschenaultia*, but the epigastric and post-orbital crests are either united to form a single ridge, or else are in the same line and are imperfectly separated only by a vague break: the cervical groove is usually very broad and very deep.—Type *B. jacquemontii* (= "*Telphusa indica*").

5. Subgenus *Liotelphusa*, nov. As *Leschenaultia*, but the epigastric and post-orbital crests are low and quite inconspicuous, and the lateral epibranchial tooth is small or obsolescent.—Type *L. lævis* (W.-M.).

6. Subgenus *Globitelphusa*, nov. As *Leschenaultia*, but the epigastric and post-orbital crests are still more inconspicuous than in *Liotelphusa*, the lateral epibranchial spine is obsolete, and the exopodite of the external maxillipeds is short and non-flagellate.—Type *G. bakeri*, A. A.

Certain new species of *Potamon* and *Potamiscus* have been briefly noticed in papers Nos. 1 and 2, the following new species of other subgenera may now be mentioned preliminary to the full diagnoses that will appear in my forthcoming report on the Indian Potamonidæ.

Genus POTAMON.

Subgenus **Geotelphusa.**

Potamon (Geotelphusa) adiatretum, sp. nov.

This species is very closely related to *P. enodc*, Kingsley, from which it differs chiefly in the bilobed front, and in the restriction of the cervical groove to that portion which bounds the mesogastric area posteriorly.

In an adult female the carapace is only $\frac{5}{8}$ inch long and $\frac{7}{8}$ inch broad.

From the Kakhyen Hills and Moulmein.

Subgenus **Paratelphusula.**

Potamon (Paratelphusula) fungosum, sp. nov.

This species comes nearest to *P. milne-edwardsi* (Wood-Mason) (= *P. wood-masoni*, Rathbun). It has the exposed surface of the

ischium of the external maxillipeds longitudinally grooved; the antero-lateral borders of the carapace cut into four salient spines, exclusive of the external orbital tooth; the carapace only slightly convex, broadly corrugated transversely (as in *P. feæ*, de Man), and closely covered with a short spongy tomentum.

From Cachar.

Potamon (*Paratelphusula*) *calvum*, sp. nov.

The exposed surface of the ischium of the external maxillipeds is *not* grooved longitudinally; the antero-lateral borders of the carapace are cut into four spines, exclusive of the external orbital tooth; and the carapace convex.

It is closely related to *P. crenuliferum*, Wood-Mason, from which it chiefly differs in having a convex, somewhat orbicular carapace, with more spiniform lateral teeth.

From Upper Tenasserim.

Genus PARATELPHUSA.

Subgenus **Phricotelphusa.**

Paratelphusa (*Phricotelphusa*) *gageii*, sp. nov.

This species is allied to *P. callianira*, de Man, and *P. carinifera*, de Man, but more closely still to *P. elegans*, de Man. The carapace has the usual one pair of blunt epigastric crests: in the external maxillipeds the exopodite is as long as the ischium (which is longitudinally grooved) and is sometimes non-flagellate, and sometimes has a papillar or filiform (never plumose) flagellum: the lateral epibranchial tooth is small or obsolescent: the length of the 6th abdominal segment of the adult male is barely equal to its distal breadth: the antennal flagellum is small but distinct: and the anterior part of the front is vertically deflexed, but does not appear as a distinct facet as it does in *P. elegans*. Like all the species of this subgenus it is small.

From Sureil near Kurseong, where, thanks to the hospitality of Captain A. T Gage, I.M.S., Superintendent of the Botanical Gardens and of the Cinchona Plantations, I collected a fine series of this species.

Subgenus **Barytelphusa.**

Paratelphusa (*Barytelphusa*) *lamellifrons*, sp. nov.

Close to *P. jacquemontii*, Rathbun (= "*Telphusa indica*" of many authors), from which it chiefly differs in the form of the front and of the post-orbital crests. The front is a thin projecting plate far overhanging the epistome: the post-orbital crests are thin, elegantly crenulate, and have their outer ends lobe-like and continuous with the edge of the carapace just in front of the lateral epibranchial tooth.

From Travancore.

Paratelphusa (Barytelphusa) pulvinata, sp. nov.

Allied to *P. cunicularis*, but having a prodigiously convex carapace, a cervical groove deep-cut in all its course, and, in the adult male, a 6th abdominal segment the greatest breadth of which is barely two-thirds its length. There is no other Indian species of this subgenus that has such a narrow abdomen.

From Coorg and Ootacamund.

Paratelphusa (Barytelphusa) pollicaris, sp. nov.

This species is, in a way, transitional between *P. (B.) jacquemontii*, Rathbun, and *P. (B.) lugubris*, Wood-Mason. The carapace is squarish and flattish and about half of its antero-lateral border lies in front of the epibranchial tooth. The epigastric and post-orbital crests are continuous, the lateral epibranchial tooth is small and not prominent: the fingers of the chelæ are very broad, particularly the fixed finger.

From South India.

In my concluding preliminary paper I hope to give brief diagnoses of some new species of *Liotelphusa* and *Globitelphusa.*

I should like to mention here that the species and varieties of the "*Potamon lugubre*" group diagnosed in my paper No. 2 do not belong to the genus *Potamon* at all: "*Potamon lugubre*," Wood-Mason, belongs to the new subgenus *Barytelphusa* of the genus *Paratelphusa*, having the terminal joint of the mandibular palp bifurcated from the base, and the 6th abdominal segment of the adult male not much broader than long.

XVI. REPORT ON A SMALL COLLECTION OF LIZARDS FROM TRAVANCORE.

By N. ANNANDALE, *D.Sc., Superintendent, Indian Museum.*

The lizards noticed or described in the following paper were collected during a trip undertaken in November, 1908, in conjunction with the Trivandrum Museum. I have to thank Lieut.-Col. F W. Dawson, Director of that institution, for permitting Mr. R. S. N. Pillay, his chief assistant, to accompany me, and also for much other assistance. Unfortunately we had no time to visit the high mountains in the northern part of the State; but after travelling by boat down the "backwaters" from Cochin to the neighbourhood of Quilon (whence we made a detour to visit the large freshwater lake at Shasthancottah) and thence to Trivandrum, we returned along the high road at the base of the Western Ghats to Tenmalai on the western side of that range, which we crossed by rail to Shencottah on the frontier of the Tinnevelli District of the Madras Presidency. Small though the collection of lizards is that we made, it throws light on some interesting problems of distribution and biology as well as including specimeus of a species not previously described.

1. *Gonatodes ornatus.*

A young specimen from under a stone by the roadside, near Kulattupuzha.

The young of this lizard are much darker than the adults, the sides, limbs, ventral surface, iris, and top of the head being dark chocolate-brown. A narrow white line extends from each nostril through the upper part of the eye to the back of the neck, where it nearly meets its fellow; from this point a broad greyish band, mottled with brown, stretches along the back, becoming obscure on the tail.

2. *Gonatodes kandianus.*

A small specimen taken at the base of a tree-trunk, beside a stream at Tenmalai, in the Western Ghats.

3. *Hemidactylus brookii.*

This is the common house lizard in the extreme south of India, in which *H. flaviviridis* appears to be rare.

It is well known that *H. brookii* possesses considerable power of temporary colour change in accordance with the amount of

direct and reflected light that falls upon it; but this change consists mainly, if not entirely, in the temporary disappearance and appearance of much of the dark pigment of the integument, owing presumably to contraction of the pigment cells. Another kind of change, however, also occurs, as was very clearly demonstrated by certain specimens taken at Shasthancottah. Some of these were captured on the whitewashed wall of a bungalow and appeared to be incapable of becoming very dark on the dorsal surface even in a dark environment. The ventral surface was always white. Other specimens taken at the same place under black stones were darker on the dorsal surface, and still remain so after six months in spirit. Their ventral surface, moreover, is dotted with dark pigment. These specimens would seem to prove that habitual living in dark surroundings produces an actual and more or less permanent increase of pigment, not merely a temporary expansion of the pigment cells.

Eggs of *H. brookii* were common under stones at Shasthancottah in November.

4. *Hemidactylus leschenaultii.*

Apparently much commoner in S. India than in Bengal. I took a specimen on the outer wall of a bungalow at Shencottah on the Madras frontier of Travancore, but have never seen one indoors.

5. *Draco dussumieri.*

Common about ten miles north of Trivandrum, but apparently very local. One of my men saw one in the jungle near Kulattupuzha, at the base of the Western Ghats.

6. *Otocryptis beddomii.*

Mr. Pillay took several specimens at Aryankavu, below the western slopes of the Western Ghats.

7. *Calotes versicolor.*

This widely distributed species is common in the plains of Travancore, and ascends the Western Ghats to an altitude of at least 3,000 feet. The examination of many living specimens from S. India, from the Western Ghats in the Bombay Presidency, and from various parts of the Himalayas and Bengal, has forced me again to reconsider the question of the differences between the typical form of this species and that called by Blyth *Calotes gigas*. As I have found a certain number of specimens which it is impossible to refer with certainty to one of these forms rather than the other, it seems to be impossible to regard them as distinct species, and I am forced to fall back on my original view (*Journ. Asiat. Soc. Bengal*, 1905, p. 87), that the race which inhabits the drier parts of India at low altitudes exhibits a much greater sexual

variation than is the case of the race which occurs in Lower Bengal, the Himalayas, Assam, Burma, Malaya and Siam; but that it is impossible to draw an exact line between the two races. *Calotes versicolor* occurs not only all over the plains of India, but all along the Himalayas as well as on isolated hills. It is common in the Darjiling district and in Nepal and Kumaon up to an altitude of over 6,000 feet, but apparently not above 7,000 feet; in the Simla district I have seen specimens near Kasauli at an altitude of 5,000 feet. Apparently, however, it does not penetrate very far into the Himalayas from the plains. On the top of Paresnath Hill in Western Bengal it is common, the height of this hill being 4,480 feet.

8. *Calotes ophiomachus.*

A small male was taken in thick jungle near Kulattupuzha at the base of the Western Ghats (west side), and was the only living specimen I saw in Travancore, although it is said not to be uncommon in that State. This individual was disturbed while digging in the ground with its fore feet, probably in search of earthworms. Although put to flight three times at intervals between the early morning and the afternoon, it returned again and again to the same place, recommenced its digging; and was captured the fourth time it was seen. Many lizards have this habit of returning to a place whence they have been scared away.

9. *Charasia blanfordiana.*

A common species as far south as Trivandrum, and probably Cape Comorin. The furthest south that I actually saw a specimen was a few miles north of Trivandrum, but there is no geographical or faunistic separation between that locality and the extreme southern point of the Indian Peninsula. The range of this species is a peculiar one. It occurs commonly on the hills of the Hazaribagh district of Western Bengal, ascending Paresnath to the height of over 4,400 feet above sea level, and is found in many rocky localities in the centre of the Indian Peninsula; on the western side of the Western Ghats it is common in Travancore, but whether its range extends northwards along this range into the Bombay Presidency I have been unable to ascertain. I have seen no record of its occurrence in the south of the Madras Presidency, although it is not uncommon in the northern central part. There are specimens in the Indian Museum from Ranchi, Chota Nagpur; Paresnath, Hazaribagh district; Chanda and Nagpur, Central Provinces; Raipur; the Eastern Ghats, and near Ellore, Madras, as well as those recently obtained at Maddathorai and Tenmalai in Travancore. In the high mountains to the north of Travancore it is replaced by the allied form *Ch. dorsalis*, which is essentially a mountain species.

The genus *Charasia* appears to take the place in the Indian Peninsula of the Palæarctic and Ethiopian genus *Agama*, which

extends along the Himalayas into the drier and colder parts of Nepal. *Ch. blanfordiana* is the only species of *Charasia* I have been able to observe alive. In its habits it closely resembles *Agama tuberculata*, being usually seen on rocks but occasionally entering human dwellings and running about on the walls. The male, in April and May, has the head and fore-quarters of a brilliant red colour, and displays his magnificence to the female, which remains concealed, by slowly walking along in some conspicuous position, alternately raising and nodding his head in a very solemn manner. The exact tint of the brilliant parts changes as he does so. Both sexes possess considerable powers of temporary colour change, which seem to be called into play mainly by the amount of reflected light that reaches the integument. The changes do not always assist in concealing the animal. I have seen a temporarily pale individual resting most conspicuous on a red mud wall, and another on a black rock from the surface of which the sun was reflected. On the other hand, other individuals on similar rocks and walls in the shade were much darker and less conspicuous. The fact seems to be that the number of different colours that can be brought into play by contraction or expansion of the pigment cells of this species is a very limited one. Strong reflected light causes certain of the pigment cells to contract, but does not expose others. The lizard, therefore, can become paler or darker, but cannot change its actual coloration to any great extent. Some of the pigment cells, however, are probably non-contractile, for the symmetrical markings never disappear but become more conspicuous as the general tone becomes paler. Specimens in spirit from Travancore are much blacker (*i.e.*, less brown) than specimens from Paresnath, on which the rocks are not so black as those of the Western Ghats of Travancore. It is probable, therefore, that in *Charasia* as in *Hemidactylus*, environment has more than a transitory effect on coloration.

10. *Mabuia carinata.*

Common in open country as well as in jungle at the base of the hills; often seen in pairs sunning itself on fallen tree-trunks or rocks.

11. *Lygosoma dussumieri.*

Perhaps the commonest skink in the plains of Travancore, both in open country and in jungle at the base of the hills. The form I described (*Journ. Asiat. Soc. Bengal*, 1905, p. 145) as "var. *concolor*" is the typical female, which is not only larger and stouter than the male, but much more soberly coloured and retiring in its habits. The tail in the male is bright red, while in the female it is brownish; the white lines running along each side of the back and sides in the former sex are obsolete or obsolescent in the female; and the same is the case as regards the dark spots on the dorsal surface.

12. *Lygosoma dawsonii*, sp. nov.

Subgenus *Keneuxia*.

Habit lacertiform, stout; the distance between the end of the snout and the fore limb 1⅓ to 1½ times in that between the axilla and the groin. Snout short, obtuse, not depressed; loreal region vertical; lower eyelid scaly; a small supranasal, which is widely separated from its fellow, but no postnasal present; frontonasal forming a broad suture with the rostral and with the frontal, which is at least as long as the parietals and the interparietal together; interparietals forming a long median suture; a pair of enlarged nuchals present; four superoculars, of which the second is in contact with the frontal and much larger than any of the others. Twenty-eight scales round the body; the dorsals, laterals, nuchals and the scales on the dorsal surface of the limbs with from three to seven strong keels. No enlarged præanals, but the ventrals much larger posteriorly than anteriorly. Dorsal surface blackish olive, darker in the adult than in the young; many parti-coloured black-and-white scales on the sides; a narrow pale line, more or less interrupted, extending from the superciliary region to a point above and a little behind the axilla, and another similar line from below the anterior border of the eye to the fore limb; throat of adult (in life) bright pink, more or less spotted with black.

Measurements of type specimen (Regd. No. 16170).

Total length	120 mm.
Length of head and body ..	58 ,,
,, ,, tail	62 ,,
,, ,, fore limb	23 ,,
,, ,, hind limb	26 ,,
,, ,, snout	4 ,,
Breadth of head	5 ,,

Habitat.—Described from an adult specimen taken at Maddathorai and from three young ones, one from Tenmalai, one from Kulattupuzha, and one from Shasthancottah, the three former places being among or at the western base of the Western Ghats, and the latter near the coast.

In some respects this species resembles the common *Mabuia carinata*, but it is a true *Lygosoma*; the coloration is very distinctive.

13. *Lygosoma albopunctatum.*

A specimen from Shasthancottah.

14. *Ristella guentheri.*

A specimen from Tenmalai, in the Western Ghats.

15. *Ristella beddomii*

A small specimen from under a stone by the roadside, near Tenmalai.

XVII. DESCRIPTIONS OF THREE NEW CICINDELINÆ (COLEOPTERA) FROM BORNEO.

By DR. WALTHER HORN, Berlin.

Collyris antennalis, sp. nov.

♀ *Coll. brevilabri* simillima, differt antennarum articulis 5—11 evidenter angustioribus longioribusque (prothoracis basim fere attingentibus); labro brevi in medio perparum rotundatoprolongato, dentibus (centrali excepta) longioribus; frontis sulcis 2 longitudinalibus multo minus profundis (non profundioribus quam in *Coll. bonelli*), parte intermedia non carinato-elevata sed fere plana, partibus orbitalibus verticalioribus, minus altis (postice vix altioribus quam antice), tota parte interoculari antice (supra clipeum) angustiore quam in illa specie; elytris paullo grossius sculptis quam in *Coll. brevilabri Weyersi* (grossius quam in forma prioritatis "*Coll. brevilabris*"); tibiis, tarsis, femorum basi, genubus testaceis. Long. 7½—8 mm.

Two ♀ ♀, Martapura (S. E. Borneo), ex coll. Dr. David Sharp: one ♀ in the collection of the British Museum, one in my own. Both were collected by Doherty in 1891.

The labrum, the 3rd to 11th segments of the antennæ and the palpi (the distal half of each last segment is dark) are testaceous; the pro- and meso-episterna without distinct pubescence, metasternum impunctate. The new species differs from *Coll. linearis* and its varieties by its smaller size, the short yellow labrum, the (regular) finer and denser punctuation of the elytra, the narrower head, etc. The eyes are less divergent posteriorly and much flatter, the middle stripe between the orbital plates narrower (especially behind). At first view the little species reminds one very much of *Coll. brevilabris*, m., by the shape of the head, prothorax and elytra. The two processes of the 7th abdominal sternite take their origin close to each other and are parallel.

Collyris constricticollis, sp. nov.

Inter *Coll. sarawakensem*, T. Thoms, et *levigatam*, m. Capite ut in hac specie, prothoracis parte constricta anteriore etiam longiore, parte conica incrassata posteriore paullo breviore (et perparum crassiore), pronoto toto regulariter grosse sat sparsim transversaliter plicato, parte angustissima prothoracis vix ante medium longitudinis sita; elytris fere ut in *Coll. sarawakensi* sculptis, in parte media sat lata grosse intricato-plicatis, antea sparsim modice grosse (punctis

gradatim basim versus diminutis), postea subtilissime rarissime (hac parte fere glabra) punctatis; primo antennarum articulo nigro-cyanescente. Long. 17—17½ mm.

Two ♀ ♀, Martapura (Doherty, 1891: ex coll. Dr. David Sharp). One specimen in my collection, one in the British Museum.

The coloration of the body, antennæ and legs is exactly like that of *Coll. levigata*, m., and (the first segment of the antennæ excepted) *sarawakensis*, Thoms. The pro- and meso-epipleuræ are exceedingly finely, the lateral part of the metasternum closely and evidently, pilose. The head differs from that of *Coll. sarawakensis* by the middle stripe of the front being not at all elevated in the form of a carina and in the evidently less highly elevated wrinkles at the base of the orbital plates. The prothorax of the new species is longer than that of *Coll. sarawakensis*, the constricted anterior part much longer and narrower, the conical basal part a little shorter and more conical. Some specimens of Thomson's species have exactly the same sculpture of the elytra as the new species.

Therates erinys, Bat., *styx*, subsp. nov.

Differt a forma prioritatis colore toto et corporis supra subtusque et antennarum et pedum et palporum et labri et mandibularum nigro; elytris pone locum illum obliquum tumidum discoidalem paullulum punctatis: punctis sensim ante quartam partem apicalem evanescentibus. Long. 9½ mm. (sine labro).

One ♂, sent to me by Mr. John Hewitt, director of the Sarawak Museum. Collected at 4,500 feet elevation in May 1899, near Mount Penrissen (Borneo).

The unique specimen is in very bad condition. The slight punctuation behind the elevated oblique middle spot runs down to about three-fourths of the length of the elytra. The extreme apical part shows again some sculpture. The entire blackish coloration is very strange.

XVIII. THE RELATION BETWEEN FERTILITY AND NORMALITY IN RATS.

By R. E. LLOYD, *D.Sc., Offg. Professor of Biology, Medical College, Calcutta.*

During a recent visit to the west of India I had an opportunity of seeing the work which was being carried on by the Plague Commission at Poona and Belgaum; at both of these places large numbers of rats were being caught daily, each rat being the subject of careful observation. The results of these observations were recorded as a matter of routine, so that no detail, which might have a bearing on the questions before the Commission, might be lost. While watching the progress of the work, and admiring the thoroughness with which it was executed, I received the idea that some of the statistics which were being accumulated might be of great value to Biology. Among the facts recorded was that of the number of young contained in each pregnant female. It is well known that among mammals which produce a number of young at a birth there is an individuality as regards that number. It is the common experience among dog fanciers, that certain bitches will always produce four or five pups at a time, while others will always produce one or two. It very rarely happens that a bitch will produce a large litter at one time and a small one at another time. Therefore we may assume that the number of young produced by a rat at any one time is a fair measure of the fertility of that rat; though imperfect it would be difficult to devise a better means of measuring this important character. From both Poona and Belgaum, I obtained the records of the fertility of one thousand rats as measured in this way. It occurred to me that a definite relation had been established between fertility and normality in the case of certain organisms. Among such organisms it had been found that those which were most normal or true to the type of their race were also the most fertile. I am indebted for this information to a book entitled " Variation in Animals and Plants " by H. M. Vernon. This book quotes the observations of Professor Karl Pearson, who counted the number of stigmatic bands on a large number of poppy capsules and the number of the seeds which ripened in each capsule. The number of the seeds was regarded as a measure of the fertility of the poppies. It was found that those plants which were abnormal as regards the number of their stigmatic bands always contained a smaller number of seeds than those which were normal.

The number of the stigmatic bands varied from 5 to 19 but the most common type of capsule possessed 12 or 13 bands. It is not surprising that those plants which possessed few bands shou'd produce few seeds, but it is most remarkable that those capsules with 18 or 19 bands should also produce few or no seeds. Similar observations were made on other plants; the following passage appears in Vernon's book: "These experiments Professor Pearson holds to illustrate a very important law, namely, 'Fertility is not uniformly distributed among all individuals, but for stable races there is a strong tendency for the character of maximum fertility to become one with the character which is the type.'" It has also been shown that certain medusæ which are abnormal as to the number of their radial canals are less fertile than those which are normal. It is plain that this law is an explanation or discovery of the means by which a race remains normal in spite of variation, for it states that normality can perpetuate itself with ease while abnormality does so with difficulty. This explanation seemed so feasible that I felt almost sure that if the fertility of these rats was to be compared with some other variable character, an interesting illustration of the law would appear. The character chosen for comparison was the weight of the rat. House rats throughout India are very variable in size; in the combined length of head and body they show a range of variation which is as wide as forty per cent. of the mean length, in weight the range is much wider even than this. The difficulties of measuring a freshly killed rat are well known to any one who has made the attempt; the length of a rat varies with the attitude it is made to assume, and the interval of time since its death. Although the weight of a rat doubtless varies according to the stage in the pregnancy reached, the contents of the stomach and the state of the nutrition, a record of the weight affords the best estimation of the total size which is available to us.

The result obtained was quite unexpected. The maximum fertility of rats (as measured by the number of young which they produce at a birth) is not one with the character which is the type, as regards size. In other words, gigantic and dwarfed rats are just as fertile as common rats of average size.

The tables I and II show the results which were obtained independently at Poona and Belgaum. The same methods were employed at both places. The rats were weighed immediately after death by chloroform, on a spring balance which was graduated to record five-gramme units. The observers had attempted to guess the weight to the nearest gramme, but it was plain from the way in which the fives and tens predominated among the records that such guessing could not be relied on. In arranging the figures, therefore, the following plan was adopted: Those numbers which ended in five or less were added to the ten group next below, while those which ended in six or more were added to the group above. A rat shown as weighing 75 gms. is placed in the seventy-gramme group, while another of 78 gms. is placed in the eighty group. It should be mentioned that the number of young within a pregnant female

rat can be counted with ease and without possibility of mistake, indeed the figures themselves are a proof of their own accuracy for the work was carried out at the two places by independent observers. In the tables the vertical column of figures on the left represents the approximate weights of the rats, the highest horizontal row of figures represents the number of the young which a female rat may carry, the other horizontal rows of figures show the numbers of rats of a particular weight which carry a particular number of young. Thus, in the case of table 1 the second row of figures shows that out of 1,003 rats which were examined, only 5 were nearly of fifty grammes weight, and that of these 3 carried five young, while the other 2 carried four and six respectively. It is plain that the rats of Poona are smaller than the rats of Belgaum, otherwise they resemble one another. Both races, if they should be called separate races, possess skulls of the *Mus rattus* type.

I.—*Observations made at Poona*

Weight of the rats	Number of the young.												Total of each array.
	1	2	3	4	5	6	7	8	9	10	11	12	
50 ..	..	..	..	1	3	1	..	..	..	..	..	..	5
60 ..	..	..	..	1	6	2	..	..	..	..	..	..	9
70 ..	..	..	2	10	17	12	4	..	1	..	..	.	46
80 ..	1	1	11	8	18	10	9	3	2	..		..	63
90 ..	2	5	7	18	30	28	12	5	1	..	..	..	108
100 ..	3	5	10	25	37	35	21	7	2	1	..	..	146
110 ..	1	4	12	19	38	37	29	6	2	..	..	..	148
120 ..	2	6	9	21	36	26	30	14	6	..	1	..	151
130 ..	4	4	9	12	35	29	17	17	6	1	1	1	136
140 ..	1	4	6	9	12	27	15	6	2	1	..	..	83
150 ..	..	3	..	2	13	11	6	6	2	..	..	..	43
160 ..	..	2	..	1	11	11	9	3	4	..	..	..	41
170 ..	1	..	1	1	2	4	2	2	1	..	1	..	15
180 ..	..	..	1	1	..	2	2	2	..	..	..	..	8
190 ..	..	..	..	..	..	..	..	..	..	1	..	..	1
TOTAL..	15	34	68	129	258	235	156	71	29	4	3	1	1003

II.—*Observations made at Belgaum.*

Weight of the rats.	Number of the young. 1	2	3	4	5	6	7	8	9	10	Total of each array.
70 ..	..	..	..	..	1	1	..	..	..	..	2
80 ..	..	..	..	10	7	5	3	..	..	..	25
90 ..	..	1	3	13	27	11	2	1	..	..	58
100 ..	2	1	1	18	43	23	14	3	..	..	105
110 ..	..	2	7	23	56	25	15	2	1	..	131
120 ..	2	2	7	23	54	40	23	1	3	..	155
130 ..	1	..	5	18	46	30	16	4	4	..	124
140 ..	2	3	7	15	39	44	18	6	3	..	137
150 ..	..	1	5	20	41	38	10	3	1	1	120
160 ..	..	2	2	4	20	18	7	7	2	..	62
170 ..	..	1	1	4	14	12	9	2	1	..	44
180 ..	..	..	..	3	9	5	4	4	..	..	25
190 ..	..	..	..	1	2	4	1	1	..	..	9
200 ..	..	..	1	2	1	..	2	..	..	..	6
210 ..	..	..	..	..	..	..	3	..	..	..	3
TOTAL ..	7	13	39	134	360	256	127	34	15	1	1006

I think that the following conclusions are justified by the figures :—

(1) At Poona, mature female rats vary in weight from 50 to 190 gms., the mean weight being about 115 gms.

(2) At Belgaum, they vary from 70 to 210 gms. with a mean of about 125 gms.

(3) At both places, rats are more likely to bear five young at a time than any other number ; they may bear as few as one or as many as ten (at Belgaum) or twelve (at Poona).

(4) At both places, rats which carry other than five young are more likely to have six young than any other number; they are more likely to have six than four. This is remarkable; it is, however, shown not only by the aggregate figures *but by nearly all the separate arrays.*

(5) As regards their fertility the rats of Belgaum are somewhat less variable than those of Poona. Not only is the range of variation among the latter wider than among the former, but rats of average fertility are more common at Belgaum than at Poona. If the values for fertility be plotted in curves, that which represented the Belgaum rats would be steeper but less wide than that which represented the rats of Poona. Both curves would be unsymmetrical in the same way

(6) There is clear evidence that the largest and smallest rats are *quite as fertile as those of average size.*

(7) There is no evidence that large rats are particularly fertile at Belgaum, or that small rats are particularly

fertile at Poona, to account for the difference in size of the two local races.

In conclusion I must explain my indebtedness to Captain White and Captain Kunhardt who were in charge of the research measures at Belgaum and Poona. It is obvious that the statistics which I have made use of, could only have resulted from months of steady work. In this I took no part, being privileged merely to watch its progress during the few days of my visits to those places.

XIX. DESCRIPTION OF A BARNACLE OF THE GENUS *SCALPELLUM* FROM MALAYSIA.

By N. ANNANDALE, *D.Sc.*, *Superintendent*, *Indian Museum.*

The Malaysian Pedunculate Cirripedes in the collection of the Indian Museum were described in the *Memoirs of the Asiatic Society of Bengal*, vol. i, in 1906; but since that date an interesting new species from the Archipelago has been acquired. It is here described.

Scalpellum (Smilium) kampeni, sp. nov.

CAPITULUM with fifteen valves, subtriangular, compressed, lined with blackish membrane, which gives the shell a greyish colour externally; the valves smooth, covered with a delicate hairless

FIG. 1.—*Scalpellum kampeni*, × 5, side view.

membrane. *Tergum* relatively very large, subrhomboidal, with the carinal angle subangulate and the scutal margin nearly straight; the occludent margin straight, vertical, about $\frac{3}{5}$ as long as the scutal; the umbo at the apex of the capitulum, whence a faint ridge runs diagonally down the valve to its base dividing it into two equal areas. *Scutum* large, triangular, with the occludent and tergal margins subequal, nearly straight and forming an acute angle which is faintly retroverted at the tip; the basal margin convex downwards, much shorter than either of the other two. *Rostrum* well developed, triangular, broader than long, not very prominent, with the basal margin convex and the two upper margins concave. *Carina* nearly straight, reaching almost to the top of the capitulum; the dorsum rounded, the lateral faces somewhat flattened on the

upper half; the umbo at the apex of the valve. *Subcarina* large, elongate, claw-shaped, very prominent, with a prominent *subcarinal latus* somewhat resembling it in shape on either side. *Median latus* small, situated between the scutum and the carina, irregularly triangular, with the carinal margin much shorter than either of the other two and distinctly convex towards the carina; the basal margin somewhat convex; the main axis of the valve tangential to the base of the capitulum. Two small, prominent, pointed latera beneath the base of each scutum. The valves slightly separated from one another by membrane.

PEDUNCLE short, sparsely covered with small, triangular, upwardly pointed plates arranged in about nine irregular rows.

APPENDAGES, etc.—*First cirri* with both rami slender, the anterior ramus with about ten joints and the posterior with eight; both well provided with long bristles on the distal joints. *Anal appendages* consisting of a single joint, laterally compressed, much longer than broad, somewhat curved inwards towards the abdominal surface; the sides parallel, the tip bluntly pointed, bearing a band of long hairs which extends down the ventral margin for some distance as a fringe. The *penis* slender, pointed, not very long.

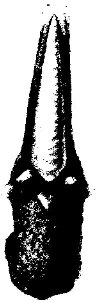


FIG. 2.—*Scalpellum kampeni*, × 5, back view.

FIG. 3.—*Scalpellum kampeni*, × 5, front view.

MOUTH PARTS.—*Labrum* slightly produced, without chitinous teeth. *Mandible* with the outer tooth larger than and widely separated from the second, which is rather smaller than the third; a fairly large subsidiary tooth situated at the base of the deep concavity between the first and the second; the inner angle broadly truncated, covered with short bristles, narrowly separated from the third tooth. *Maxillæ* relatively large; the free edge without a definite incisure but slightly sinuous as a whole; a pair of very

stout bristles at the outer angle and a bunch of fine hairs at the inner angle, which is rounded; the intermediate bristles of various sizes, fairly stout. *Second maxilla* not distinctly bilobed.

Length of capitulum	..	..	7 mm.
Breadth of ,,	..	..	4 ,,
Thickness of ,,	..	..	1·5 ,,

MALE.—A single male was found in the usual position at the edge of the scutum. It was attached in a little depression on the edge of the mantle and may be described as follows:—Capitulum not very clearly separated from the peduncle, which is broad above and

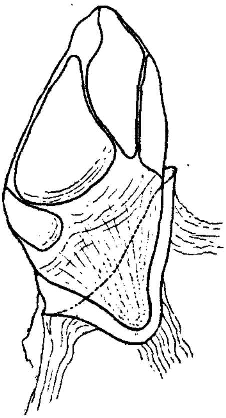


FIG. 4.—Complemental male of *S. kampeni* in pit at edge of mantle of hermaphrodite, × 30.

tapers at the base. Six relatively large, closely adjacent, feebly calcified valves present—a carina and rostrum, a pair of terga and one of scuta. Tergum slightly smaller than the scutum, somewhat irregular in shape, pointed above. Scutum triangular, with its tergal margin somewhat sinuous and its basal and occludent margins convex. Carina triangular, with the base convex downwards; the apex considerably below that of the tergum, and the base situated nearer the base of the capitulum than that of the same valve. The rostrum shaped as in the hermaphrodite but relatively much larger.

Total length of male ..	..	0·92 mm.
Breadth of capitulum of male	..	0·44 ,,

HABITAT.—A single specimen from Lat. 0° 14′ N., Long. 104° 42′ E.; between 13 and 16 fathoms. I am indebted for this specimen, which is attached to the spine of a sea-urchin, to Dr. P. van Kampen. It is numbered $\frac{5727}{10}$ in the Indian Museum register of Crustacea.

Scalpellum kampeni is a primitive form which would come in Hoek's division *Protoscalpellum* (Hoek, *Sib. Exp.*, Mono. xxxi*a*, p. 58), and would by Pilsbry be placed in the genus *Smilium* (*Proc. Acad. Nat. Sci. Philadelphia*, lx, p. 107, 1908).

I take this opportunity to state, as has already been inferred in the explanation to plate iii, Crust. Ent., of the *Illustrations of the "Investigator,"* that *Scalpellum pellicatum*, Hoek (*op. cit.*, p. 91), is in my opinion a variety of the species previously described by me as *S. sociabile*. The anatomical differences noted by Hoek are variable characters, and the mouth parts of the specimen I figured and described were abnormal (see *Mem. Ind. Mus.*, ii, p. 84, 1909). The form of the anal appendages is very characteristic.

The same author's *S. stearnsi* var. *gemina* only differs very slightly from the form I described as *S. inerme*, which is undoubtedly a variety of the species to which Hoek referred his specimens. *S. stearnsi* is very closely related to *S. magnum*[1] of the Coralline Crag of Sudbourne, but may perhaps be distinguished by the fact that the carinal latus is not turned upwards at the tip and does not project in so marked a manner. This, however, seems to be a somewhat doubtful character in the fossil form, and, indeed, a variable one in the recent species. That *S. stearnsi* is the direct descendant of *S. magnum* there cannot, at any rate, be any doubt.

[1] Darwin, *Mon. Fossil Lepadidæ*, p. 18, pl. i, fig. 1 (1851).

XX. THE HEMIPTEROUS FAMILY POLYCTENIDÆ.

By DR. P. SPEISER.

There are among the parasites of bats very singular forms; but we are far from an even nearly complete knowledge of these small auimals, because bats seldom receive attention from sportsmen. Several forms of these parasites, and specially interesting ones too, are known only from a few isolated individuals. In the genus *Ascodipteron*, which forms one of the best characterised families, only five females are known, and no male; while examples of another parasitic genus (*Polyctenes*), of which I have recently received a specimen by the great kindness of Dr. N. Annandale, of the Calcutta Museum, are likewise rarities. I take the opportunity, therefore, to give here a more complete review of the family they represent.

In 1864 Giglioli described the parasite of a Molossid from Amoy, in China, under the name "*Polyctenes*," which was proposed to the author by Westwood. At that time no other insects from bats but Diptera were known; these Diptera were all classified together as "Nycteribiidæ," and therefore the new genus was placed in the family Nycteribiidæ. The family "Streblidæ," founded in 1862, contained winged species only, *Polyctenes* being wingless. Westwood took occasion later, having got a second species, to examine the first one known in the exactest manner. In his *Thesaurus Entomologicus Oxoniensis* he gives very much enlarged and carefully delineated figures of all details. He ascertained thus that *Polyctenes* undergoes an ametabolic metamorphosis, and that it has a three-jointed proboscis.

As these characters, both important, do not allow the species to be placed among the Diptera, he brought the genus into the Anoplura by the side of the true lice and the bird-lice (Mallophaga). C. O. Waterhouse, who was able to describe in 1880 another American species, called attention to their relationship with the Hemiptera, and not with the Diptera. But these singular parasites came by rare exceptions only into museums, and therefore few scientists knew them by a personal examination. The few notes on their systematic position were disregarded, and the Polyctenidæ were still enumerated as late as 1896 among the Dipterous family Nycteribiidæ. Finally, I was able to examine two new species myself and to point out the systematic position in a more exact manner. These insects are true Hemiptera Heteroptera, and must be placed in the strictest relationship to the bed-bug. They have,

phylogenetically speaking, taken the important step from periodical blood-sucking to parasitism for life. They form a well characterised family, Polyctenidæ, which must be placed close by the side of the Acanthiadæ (Cimicidæ).

Of the genus *Polyctenes*, Gigl., seven species are known up to date:—

P. molossus, Gigl., "from the Chinese Molossus," from Amoy.
P. lyræ, Waterh., from *Megaderma lyra*, from Secunderabad (Madras Presidency).
P. intermedius, Speiser, from *Taphozous perforatus*, from Egypt.
P. talpa, Speiser, from *Megaderma spasma*, L., from Nias.
P. spasmæ, Waterh., from the same bat, from Java.
P. longiceps, Waterh., from *Molossus abrasus*, Temm., from Cajabon in Guatemala.
P. fumarius, Westw., from *Molossus rufus* var. *obscurus*, Geoffr., from Jamaica.

These seven species were described each from two specimens only, and besides these typical specimens there were found very few others; as far as I know, there are two more specimens of *P. intermedius*, mihi, and two American ones in museums.

The nineteenth specimen of this rare family, which was found by Dr. N. Annandale in November, 1908, at Trivandrum in Travancore on a specimen of *Cynopterus marginatus* in the local museum, seems to be the most interesting one except those first known. It belongs most probably to my *P. talpa*. It is not, however, a mature insect, but a nymph.

If we compare the drawings given by former authors, the new specimen seems to belong to *P. lyræ*, which is to be placed as a close ally, for it has, like this species, no ctenidia on the "elytra." The elytra, on the other hand, are longer than in *P. spasmæ*, the other species with which it must be compared particularly. The outline of the thorax agrees better with that of this latter species, but the bristles of the abdomen are in their arrangement quite different from those of any other form. A more detailed examination under the microscope showed that within the skin of this individual, which has no ctenidia on the thorax or on the elytra, was hidden as in its nymphal skin a new stage, which has such ctenidia on the thorax and on the elytra. For this reason the specimen cannot belong to *P. lyræ*, because that species has elytra without ctenidia while in a stage at which the thorax is already provided with its ctenidium. Of course it may be that the new individual is the connecting stage between *P. spasmæ* and *P. talpa*, which inhabit the same host. Then *P. spasmæ* would be the larval stage, the new specimen the nymph and *P. talpa* the full-grown insect. Be this as it may, it is now my duty to describe the peculiarities of the specimen from Travancore, which belongs certainly to the same species as *P. talpa*, mihi.

In the head and its appendages no peculiarity can be found except that the bristle at the hind angles of the dorsal surface is

wanting. The thorax has an outline somewhat different from that of the imago; it is widest a little before the middle of its length, whilst it reaches its greatest width in the imago behind this point. The arrangement of the bristles is exactly the same as in the imago, but the oblique rows of longer bristles on the anterior half contain on each side five instead of three bristles. The concave round impressions on the lateral and hinder parts are absent; they are wanting also on the elytra, which are a little shorter than in the imago. Their length is not greater than four-fifths of the width in the anterior part. The arrangement of the bristles on the abdomen is closely similar to that of *P. talpa*, mihi, as figured by me (1904) in the description of this species. The first segments are in the nymph also naked on the disk and bear on the hind border a simple row of very short bristles. But they bear at the posterior angles of the tergites on each side one longer bristle, which is not present in the imago. In this latter the segments vi to viii of the tergum are beset on their surface with many fine bristles, and on the hind border with considerably longer and stronger ones; while in the nymph they are all quite bare on their disk, and the seventh and eighth only bear the longer marginal bristles. The bristles on the sternal surface are also thinner than in the imago. The sternites bear scarcely more than a single row of very fine bristles, and in some cases in the middle before this a small group of similar ones.

A matter of peculiar importance is the structure of the tarsi. In the *Polyctenes* as yet known they must be described as four-jointed, but in this nymph they are clearly three-jointed in both the hinder pairs of feet. By this observation I find confirmed, in a very gratifying manner, what I asserted in 1904, namely, that the second and third tarsal joint of the Polyctenidæ is homologous with the second or middle tarsal joint of the other Hemiptera. For in the nymph now known this joint is, in fact, as I postulated then, the second tarsal joint not yet divided into two. From this statement arises a new and unexpected support to my views on the systematic position of the family Polyctenidæ.

The important results reached by the finding of this new specimen of the rare family may be enumerated as follows:—

(1) The Polyctenidæ are now with greater accuracy than before put in close affinity with the Acanthiadæ (Cimicidæ).

(2) The ctenidia on the head are phylogenetically older characters than those on the elytra, and the latter are older than those on the thorax: they appear within the individual life in this succession: the ctenidium on the elytra appears at a time when a ctenidium on the thorax is lacking (in *P. lyræ*, this being a nymphal stage).

(3) *P. spasmæ*, Waterh., may be perhaps a larval stage of *P. talpa*, mihi; should this be proved by specimens found later, the much older name given by Waterhouse has the priority.

To solve many other questions it would be of the greatest importance that we should be able to examine more individuals of this interesting family. Collectors and scientists who have an opportunity to examine bats in the countries where Polyctenidæ can be found (South Asia and tropical America) may be prayed to pay attention to these ectoparasitic insects as well as others on the bats; for the Nycteribiidæ certainly contain within their family many questions also to be solved. Whatever is collected must be preserved in alcohol, for only in specimens so prepared can the stages of metamorphosis contained within the skin be seen and examined.

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XXI. NOTES ON FRESHWATER SPONGES.

By N. Annandale, *D.Sc.*, *Superintendent, Indian Museum.*

XI.—Description of a new species of *Spongilla* from Orissa.

Genus Spongilla.

Subgenus Euspongilla.

Spongilla hemephydatia, sp. nov.

Sponge soft, fragile, amorphous, of a dirty yellow colour, with large oscula, which are not conspicuously raised above the surface but open into very wide channels in the substance of the sponge. The oscular collars are fairly well developed, but the subepidermal space is not extensive.

Skeleton diffuse, consisting of very fine radiating fibres, which are crossed at wide and irregular intervals by still finer transverse ones; very little chitinoid substance present.

Spicules.—Skeleton spicules smooth, slender, sharply pointed at both ends, nearly straight. No true flesh spicules. Gemmule spicules straight or nearly so, cylindrical, obscurely pointed, clothed with short, sharp, straight spines, which are very numerous, but not markedly longer, at the two ends; these spicules frequently found free in the parenchyma.

Gemmules numerous, small, free, spherical, yellow, with a well-developed granular coat (in which the spicules are arranged almost horizontally) and external to it a fine membrane, which in preserved specimens becomes puckered owing to unequal contraction; each gemmule with a single aperture, provided with a straight, rather wide but very delicate foraminal tubule.

Measurements of spicules and gemmules.

Length of skeleton spicule	..	0·313 mm.
Breadth ,, ,,	..	0·012 ,,
Length of gemmule spicule	..	0·062 ,,
Breadth ,, ,,	..	0·004 ,,
Diameter of gemmule ..	..	0·313—0·365 mm.

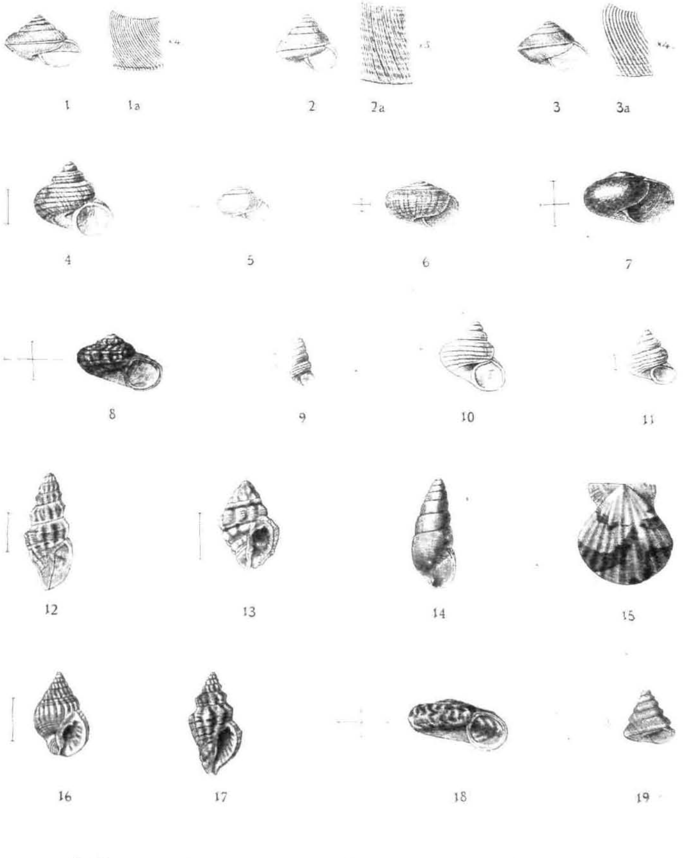
This sponge in its general structure bears a very close resemblance to *Ephydatia crateriformis*.

Habitat.—Growing on weeds at the edge of the Sur Lake, Orissa, October, 1908. Only one specimen was taken, together with many examples of *S. lacustris* subsp. *reticulata*, *S. carteri* and *S. crassissima*.

EXPLANATION OF PLATE XXII.

[*N.B.*—The text-matter to which this plate relates will be found at p. 133, part ii of the present volume of these "Records."]

FIG. 1.—*Euplecta foveolata.*
,, 1*a*.— ,, ,, sculpture magnified.
,, 2.— ,, *lankaensis.*
,, 2*a*.— ,, ,, sculpture magnified.
,, 3.— ,, *neglecta.*
,, 3*a*.— ,, ,, sculpture magnified.
,, 4.—*Leptopoma taprobanensis.*
,, 5.—*Microcystis edithæ.*
,, 6.— ,, *thwaitesi* var. *depressa.*
,, 7.— ,, *winifredæ.*
,, 8.—*Cyclophorus liratulus.*
,, 9.—*Cyathopoma perconoideum.*
,, 10.— ,, *uvaense*
,, 11.— ,, *ogdeniana.*
,, 12.– *Mangilia (Daphnella) angusticincta.*
,, 13.—*Engina purpureocincta.*
,, 14.—*Glessula sinhila.*
,, 15.—*Pecten helleri.*
,, 16.—*Nassa shawi.*
,, 17.—*Pentadactylus ceylonicum.*
,, 18.—*Cyclophorus (Theobaldia) liliputiana.*
,, 19.—*Thysanota elegans.*



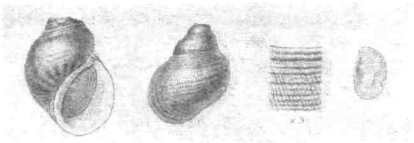
Shells from Ceylon and South India.

XXII. DESCRIPTIONS OF TWO NEW SHELLS FROM SOUTH INDIA.

By H. B. PRESTON, *F.Z.S.*

Paludomus annandalei, sp. nov.

Shell conoidal, upper whorls eroded, solid, dark olivaceous brown, a paler yellowish brown band appearing at the periphery, above this obscurely painted with regular, transverse, vertical, deep chestnut flammules and below with very oblique flammules of the same colour; remaining whorls about 3, sculptured with revolving, spiral liræ rather coarser just below the sutures and disappearing altogether or becoming obsolete towards the periphery, but reappearing on the base of the shell, the interstices between the liræ having a somewhat punctate appearance; sutures lightly impressed; columella arched, white and diffused into a minutely granular callus which joins the upper lip and is thickened almost into a nodule above; peristome acute, scarcely serrated; interior of shell bluish white, showing the rows of flammules distinctly; operculum spirally laminiferous, with subcentral nucleus.



A B C D

FIG. 1.—A, B, *Paludomus annandalei*, sp. nov.; C, Sculpture of same enlarged; D, operculum of same.

The dimensions of the three specimens taken as the type series are as follows:—

	(1)	(2)	(3)
Altitude ..	.. 24 mm.	22 mm.	21·5 mm.
Diam., major	.. 18 ,,	17 ,,	16 ,,
Aperture, alt.	.. 16 ,,	13 ,,	12·5 ,,
,, diam.	.. 9·5 ,,	8 ,,	8 ,,

Habitat.—Tenmalai, W. Ghats (W. side), Travancore (rocky mountain stream); N. Annandale coll., November, 1908.

Types in Indian Museum. Regd. No. M. $\frac{4610}{1}$.

Modiola cochinensis, sp. nov.

Shell subtrapezoidal, moderately swollen, brownish black marked with coarse, concentric lines of growth; umbones rather large, prominent; dorsal margin rapidly sloping anteriorly, slightly arched posteriorly; central margin curved; anterior side sharply

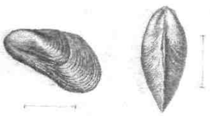


FIG. 2.—*Modiola cochinensis*, sp. nov., × 2.

rounded; posterior side acuminately rounded; interior of shell bronze, nacreous showing faint traces of radiate striation.

Long.	..	..	..	5 mm.
Lat.	..	..	..	10·5 ,,

Habitat.—Backwater near Cochin (slightly brackish water); N. Annandale coll., November, 1908.

Types in Indian Museum. Regd. No. M. $\frac{4612}{1}$.

XXIII. PRELIMINARY NOTE ON A NEW GENUS OF PHYLACTOLÆMATOUS POLYZOA.

By N. ANNANDALE, *D.Sc.*, *Superintendent*, *Indian Museum*.

The first specimens of the new genus were sent to the Indian Museum by Major H. J. Walton, I.M.S., from Bulandshahr in the United Provinces, but others have recently been found in the outskirts of Calcutta by Mr. B. L. Chaudhuri and myself.

Stolella indica on stem of water plant.

STOLELLA, gen. nov.

Phylactolæmatous Polyzoa with horse-shoe-shaped lophophores and small statoblasts (both free and fixed) resembling those of *Plumatella*; the zoarium consisting of groups of upright zoœcia (or occasionally single zoœcia) joined together by an adherent pseudostolon in a linear series, the pseudostolon consisting of a prolongation in one direction of the base of one of the zoœcia; no gelatinous investment present.

Stolella indica, sp. nov.

Ectocyst of zoœcia and pseudostolon soft, colourless and transparent but minutely roughened on the external surface.

Zoœcia short, slender, more or less cask-shaped, generally more slender at the tip than at the base, emarginate at the distal end on one side and with a furrow running down from the emargination. Daughter zoœcia arise as buds at the sides of a parent zoœcium, the base of which is produced anteriorly into a tubular outgrowth of very variable length. This forms the pseudostolon, at the extremity of which a new parent zoœcium is produced; it is generally more slender either at the distal or the proximal end than at the other, and in young colonies is often somewhat difficult to detect. The pseudostolon is not distinctly marked off from the zoœcium.

Tentacles numbering 30 to 35, rather short, being stout and slightly clubbed at the tip.

Stomach short, abruptly truncated at the base.

Statoblasts.—Fixed statoblasts very variable in shape, sometimes almost circular, sometimes elongate, without external ornamentation, with a stout chitinous ring. Free statoblasts small, usually rather broad but variable in shape, oval or subrhomboidal, resembling those of *Plumatella punctata* in general appearance.

A full description of the species will be published later in a revision of the Freshwater Polyzoa of the Oriental Region now in progress.

MISCELLANEA.

REPTILES.

MAJOR WALL ON SOME FORMS OF *Dipsadomorphus*.—In the last part of the *Records of the Indian Museum* (vol. iii, p. 151) a paper was published by Major F. Wall, I.M.S., on some forms of *Dipsadomorphus*, in which several so called new species were described. Major Wall's accuracy of observation renders the statistics he provides of special value, but I feel bound to differ from him in the views he expresses.

After acknowledging that "Many of the forms now recognized as species in the genus *Dipsadomorphus* exhibit extremely close affinities" and stating that he has "examined no less than thirteen of the twenty-three known," he goes on to say, "I have for a long time thought that the species *ceylonensis* and *hexagonotus*, as regarded by Mr. Boulenger in his Catalogue (1896), comprise more than one form fit to rank as a species." He then proceeds to describe four of these forms which have been "identified as *ceylonensis*." Without defining in any way the old species *ceylonensis*, he gives as a description of each of these four "species" merely the number of rows of scales and of the ventrals and subcaudals. We might take it therefore that these points provide, in his opinion, all that is necessary to distinguish the four species from one another or from any of the remaining twenty odd species belonging to the genus, ten of which he has not seen. Would that the identification of snakes were so easy a matter! But perhaps he assumes Mr. Boulenger's description of *D. ceylonensis* as axiomatic.

Major Wall has examined at least six specimens of each of his four "species," and in one case as many as twenty-one; the range of ventrals and subcaudals, in the whole series, is very considerable. The rows of scales, however, only vary from 19 to 21, and if they are disregarded, the numbers of the ventrals and subcaudals overlap in the different "species." Moreover, Major Wall himself provides evidence that his different species cannot be regarded even as local races, such as we might almost expect to find in an isolated group of islands like the Andamans. I would much rather regard several of the admittedly allied forms in the genus as forms of one species than accept the four species into which *D. ceylonensis* has been divided by Major Wall.

Major Wall's views as to the question "What is a species?" appear to be those now held by so many zoologists that I do not think I would have been justified as editor of these "Records" in refusing to publish his paper. His enthusiasm is worthy of all praise. I feel, however, that some protest is necessary, not so much

against Major Wall's views as to the species of *Dipsadomorphus* (which are based on a great deal more material than is often the case) as against the tendency they illustrate. If every little difference between individuals or sets of individuals is to be regarded as of specific value, "philosophical" zoology must cease to exist, and all zoologists must busy themselves in searching for such differences as diligently as the stamp-collector counts the number of perforations on his specimens.

N. ANNANDALE.

BATRACHIA.

Notes on Indian Batrachia :—

1. *Rana vicina*, STOLICZKA.—*Rana vicina* was described in 1872 by the late Dr. F. Stoliczka, and the type specimen, which came from Murree, is still in the Indian Museum, its registered number being 9147.

Mr. Boulenger in his volume on the Reptiles and Batrachia in the "Fauna" (1890) queried the species as a synonym of *R. liebigii*, Günther, but Mr. W. L. Sclater, in his list of the Batrachia in the collection of the Indian Museum (1892), regarded it as distinct. In 1905 Mr. Boulenger suggested that the form was identical with the species he had described in 1882 as *Rana blanfordii*, a view which he confirmed in 1907 after examining specimens of *R. blanfordii* from the neighbourhood of Naini Tal. Accepting this view, I described (1908) the tadpole of the form common at Naini Tal as that of *R. vicina*, pointing out the characters in which it differed from the larva of *R. pleskii* and *R. liebigii*. Having recently, however, had occasion to compare considerable numbers of specimens from the Western Himalayas with the type of *R. vicina*, I detected what appeared to be constant differences. Besides the type there was one other specimen in the collection from the Western Himalayas identified by Mr. Sclater as *R. vicina*, namely, a large individual from Simla presented many years ago by Lieut. A. Newnham. A careful comparison between these two specimens convinced me that they represented the same species, and that this species differed from the form common at Naini Tal. The only difference that I could detect between the two specimens was that the type of *R. vicina* was considerably smaller than the specimen from Simla. I therefore sent the latter to Mr. Boulenger, who agrees with me that it is not his *R. blanfordii* and regards it as a specimen of *R. liebigii*. Without seeing the type he naturally prefers not to express an opinion as to its identity, but he has courteously asked me to publish a note on the subject. The following is a summary of what can be discovered about the two forms; for I think that there can be no doubt that *R. vicina* is distinct from *R. blanfordii*.

R. blanfordii is distinguished from *R. liebigii* (1) by its smaller size, its maximum length without the limbs being 49 mm. while *R. liebigii* grows at least 90 mm. long; (2) by the fact that the males

do not develop nuptial excrescences on the fore limbs at the breeding season and are devoid of vocal sacs; (3) by its stouter habit; and (4) by its darker and more purple coloration.

From the type of *R. vicina* it differs in exactly the same characters so far as can be seen, for this specimen, not being a breeding male, provides no information as regards the nuptial excrescences. The type of *R. vicina* measures 60 mm. in length, but it agrees in all other respects with the specimen from Simla measuring 77 mm. in length. I can detect no difference between it and typical specimens of *R. liebigii* from the Eastern Himalayas.

The synonymy of *R. blanfordii*, which must be considered a "good" species, is as follows:—

R. blanfordii, *Boulenger, Cat. Batr. Sal. Brit. Mus.*, p. 23 (1882).
(?) R. vicina, *id.*, *Ann. Mag. Nat. Hist.* (7), xvi, p. 640 (1903).
R. vicina, *id.* (nec *Stoliczka*), *Rec. Ind. Mus.*, i, p. 150 (1907); *Annandale*, *ibid.*, ii, p. 304, and (tadpole), ii, p. 346.

The type of *R. blanfordii* came either from Arabia or from Darjiling, but the species is common in Kumaon, Garhwal and the Simla district at altitudes of between 6,000 and 9,000 feet. In wet weather and in places where there is a plentiful water-supply it is aquatic in habits. In the neighbourhood of Simla, however, it conceals itself during the dry season. If it occurs in the Eastern Himalayas, it must be very rare. Large tadpoles are common in the W. Himalayas in mountain streamlets and in wells both in May and September.

R. vicina, on the other hand, must be regarded as a synonym of *R. liebigii*. This species is very common in the Darjiling district at altitudes of 5,000—8,000 feet. Living in a much damper climate than that of the Western Himalayas, it is not so essentially aquatic in its habits but is found in damp jungle. It also occurs in the Punjab Himalayas, but is there very rare.

2. *Bufo stomaticus*, LÜTKEN.—During the last few years I have had the opportunity of examining large numbers of living and preserved toads from Bengal, the Eastern Himalayas, the United Provinces and the Punjab. A species that has puzzled me much is the form described in 1862 by Professor Lütken, and redescribed by Mr. Boulenger in 1891 (*Ann. Mag. Nat. Hist.* (6), vii, p. 463) as *Bufo stomaticus*. This form was not described in the latter author's volume on the Reptiles and Batrachia in the *Fauna of British India* (1890), because in the original description the habitat of the species was not given. Mr. Boulenger, however, in 1891 recognized *B. stomaticus* as distinct from *B. andersonii*. while Mr. W. L. Sclater (*P. Z. S.*, 1892, p. 347) wrote that *B. stomaticus* had hitherto been confounded with *B. andersonii*. *B. andersonii* is recorded from Arabia and North-Western India (Boulenger) and from Purneah in Northern Bengal (Sclater); *B. stomaticus* from Lower Bengal, the Darjiling Himalayas up to 5,000 feet (Annandale), Assam and Burma (Sclater).

Comparing Mr. Boulenger's descriptions of the two species, the following differences appear :—

(1) *B. andersonii* has a tarsal fold ; *B. stomaticus* has not.
(2) In *B. andersonii* the tympanum is round ; in *B. stomaticus* vertically oval.
(3) In *B. andersonii* the first finger extends as far as or slightly further than the second ; in *B. stomaticus* the first finger is longer than the second.
(4) In *B. andersonii* the toes are two-thirds or half webbed ; in *B. stomaticus* three-quarters.

Mr. Boulenger regards the first of these differences as the most important, and it is the only one that has made me hesitate in uniting the two species. I have recently found, however, that it is one easily produced by the method of preservation. In living specimens from Calcutta, or in specimens preserved in weak spirit or in formalin, there is no fold ; while specimens in which the fold was absent during life develop a fold if preserved in strong spirit, owing to shrinkage of the soft tissues. Such examples are often indistinguishable from specimens from North-Western India. As regards the proportionate length of the fingers, the shape of the tympanum and the degree to which the toes are webbed, considerable variation exists even among individuals taken together in the same place, nor can any one condition as regards any of these points be correlated with any one locality, for the characters are as variable in individuals from Calcutta as they are in those from Lucknow, Allahabad or Simla. In some individuals the dorsal surface is olive green ; more frequently it is grey. The ventral surface is occasionally splotched with black. I see no reason, therefore, to separate the two species ; and as *B. stomaticus* was described in 1862, the name has priority over that of *B. andersonii*, which was described in 1883.

B. stomaticus is common in Calcutta, although owing to its strictly nocturnal habits it is rarely seen ; for unlike *B. melanostictus*, which comes out in large numbers at dusk or even during the daytime in wet weather, it remains concealed until night has fallen. Large numbers may be found during the rains huddled together in the many crevices afforded by the tree trunks of the Peepuls (*Ficus religiosa*) on the *maidan*. They make their way up these crevices to the height of five or six feet from the ground.

3. A SMALL COLLECTION FROM TRAVANCORE AND COCHIN.—The majority of the specimens here recorded were obtained in November, 1908, at or near the base of the Western Ghats in the State of Travancore. A few, however, were taken at Ernakulam in the neighbouring State of Cochin.

Rana hexadactyla.

A very common species in the plains of Travancore. Two colour varieties can be distinguished :—

Var. *a*. Dorsal surface brown, usually with a median pale stripe.

Var. *b*. Dorsal surface striped longitudinally with grey and white.

Variety *b* retains in maturity the juvenile coloration.

Localities.—Ernakulam, Kerumadi, Virkulai, Shasthancottah, Maddathorai.

Rana cyanophlyctis.

As common as the last in open country.

Localities.—Ernakulam, Vykkam, Kulattupuzha.

Rana verrucosa.

Common among stones at the edge of streams running down from the W. stern Ghats; a jungle species.

Localities.—Kulattupuzha, Maddathorai, Tenmalai.

Rana tigrina.

A common species in open country.

Localities.—Vykkam, Shasthancottah, Shencottah.

Rana limnocharis.

Common in open country and also in jungle at the base of the hills.

Localities—Kerumadi, Vykkam, Trivandrum, Shencottah, Maddathorai.

Rana beddomii.

A single specimen taken with *R. verrucosa* at the edge of a rocky stream at Tenmalai in the Western Ghats.

Rana leptodactyla.

Common at Tenmalai with *R. verrucosa.*

Rana temporalis.

Not uncommon at Tenmalai but difficult to catch owing to its activity and wariness. Single individuals often sit on rocks in exposed situations near streams. When disturbed they leap into the streams and rapidly swim to the other side.

The colour of the back in life varies from nearly orange to dark chocolate.

Rhacophorus maculatus.

A specimen from Shasthancottah. Probably not uncommon.

Micrixalus fuscus.

A single specimen from the edge of a jungle stream at Maddathorai. The back of the thighs was bright lemon-yellow in life.

Ixalus nasutus.

A common species in long grass at the base of the Western Ghats.

Localities.—Kulattupuzha, Tenmalai.

Microhyla rubra.

Apparently abundant in open country. Tadpoles are common in November in little pools of rain-water in the sand near Trivandrum.

Bufo melanostictus.

Common all over the plains. Some specimens from Ernakulam are unusually dark, the ventral surface being black marbled with white.

Ichthyophis glutinosa.

A specimen was taken at Maddathorai in a hollow tree. It had the whole of the ventral surface pure white and therefore differed in appearance from the typical form. A careful comparison, however, with normal specimens, including a microscopic examination of the scales, reveals no other difference.

I propose to call the form with the white ventral surface—var. *tricolor.*

N. ANNANDALE.

FISH.

Notes on Indian Freshwater Fish :—

1. LIST OF FISHES FROM SUR LAKE, ORISSA.—The following species of fish were obtained by Dr. Annandale from the Sur Lake on the 22nd October, 1908. According to the Bengal District Gazetteer, Puri volume, p. 6, the Sur (or Sar) Lake is a freshwater lagoon to the east of Puri town which is formed by a backwater of the Bhargavi river. The lake is four miles long from east to west, and two miles broad from north to south. It has no outlet to the sea, from which it is separated by desolate sandy ridges :—

TELEOSTEI—

Physostomi—

SYMBRANCHIDÆ—

Amphipnous cuchia.

CYPRINIDÆ—

COBITIDINÆ—

Lepidocephalichthys guntea.

CYPRININÆ—

Barbus chola.
,, *sarana.*
,, *stigma.*
,, *ticto.*
Nuria danrica.
Chela bacaila.

CYPRINODONTIDÆ—

Haplochilus panchax.

SCOMBRESOCIDÆ—

Belone cancila.

Acanthopterygii—

NANDIDÆ—

Nandus marmoratus.

RHYNCHOBDELLIDÆ—

Rhynchobdella aculeata.
Mastacembelus armatus.
,, *pancalus.*

OPHIOCEPHALIDÆ—

Ophiocephalus punctatus.
,, *gachua.*

LABYRINTHICI—

Anabas scandens.

All the above are widely distributed forms and the only notable feature of the collection is the absence of Siluridæ.

2. LIST OF FISH FROM GIRIDIH.—The following fish were identified in the Giridih subdivision of the Hazaribagh district, W. Bengal, during January and February, 1909:—

TELEOSTEI—

Physostomi—

SILURIDÆ—

Macrones cavasius. R. Barakur.
Wallago attu ,,

CYPRINIDÆ—

CYPRININÆ—

Labeo bata. R. Barakur.
,, *boga.* Giridih tanks. R. Barakur.
,, *boggut.* R. Barakur.
,, *kalbasu.* R. Barakur.
,, *pangusia.* Giridih tanks.
Catla buchanani. Giridih tanks.
Cirrhina mrigala. Pachamba tank.
Barbus chagunio. R. Barakur.
,, *chrysopoma.* ,,
,, *conchonius.* Pachamba tank.
,, *stigma.* ,, ,, Barakur village tank.
Rasbora daniconius. ,, ,,
Amblypharyngodon mola. ,, ,,
Barilius bola. R. Barakur.
Chela bacaila. Pachamba tank.

Acanthopterygii

GOBIIDÆ—

Gobius giuris. Tank at Barakur village.

OPHIOCEPHALIDÆ—

Ophiocephalus punctatus. Pachamba tank.
,, *gachua.* ,, ,, Barakur village tank.
,, *striatus.* ,, ,,

3. FISH FROM TRAVANCORE AND COCHIN.—The fish here recorded were taken by Dr. N. Annandale in November, 1908.

A considerable number of the specimens are from Shasthancottah Lake, which is situated in a deep rift in the laterite rocks about twelve miles north-north-east of Quilon on the coast of Travancore. This lake is about twelve miles long and a mile to a mile and a half broad: it has no connection with the sea but lies so deep in its rift that it gives the surrounding country the appearance of being high ground although in reality but little above sea-level.

All the specimens from Tenmalai (unless otherwise stated) are from a rocky mountain stream running down from the Western Ghats to the Malabar Coast. The Courtallum specimens are from a similar stream running in the opposite direction, *i.e.*, towards the Coromandel Coast.

TELEOSTEI—

Physostomi—

SILURIDÆ—

Clarias magur. Shasthancottah Lake.
Macrones chryseus. ,, ,,
,, *vittatus.* ,, ,,

CYPRINIDÆ—

CYPRININÆ—

Homaloptera maculata. Tenmalai.
Discognathus lamta. ,,
Amblypharyngodon melettinus. Shasthancottah Lake.
Barbus arulius. Kulattupuzha. Tenmalai.
,, *curmuca.* Changitypaulum.
,, *lithopidos.* Nimutai.
,, *mahecola.* Shasthancottah Lake.
,, *malabaricus.* Camp Gorge, Tenmalai. Nimutai.
,, *melanampyx.* ,, ,, ,, In small pond on roadside near Tenmalai. Kulattupuzha. Maddathorai. Kerumadi.
,, *melanostigma.* Kulattupuzha.
,, *stigma.* Kerumadi. South end of Vimbanad Lake.
,, *wynaadensis.* Tenmalai.
Rasbora daniconius. ,, Camp Gorge, Maddathorai. Also in small pool on roadside near Tenmalai.
Danio malabaricus. Maddathorai. Courtallum.
Barilius bakeri. Camp Gorge, Tenmalai.
Perilampus laubuca. Shasthancottah Lake.

COBITIDINÆ—

Nemachilus triangularis. River near Kulattupuzha, W. base of W. Ghats. Tenmalai.

CYPRINODONTIDÆ—

Haplochilus lineatus. Shasthancottah Lake, 12 miles N. N. E. of Quilon.
,, *panchax.* Kerumadi. Shasthancottah Lake.

SCOMBRESOCIDÆ—

Belone cancila. South end of Vimbanad Lake.

Acanthopterygii—

PERCIDÆ—

Ambassis myops. Ernakulam (Cochin).
,, *nalua.* Shasthancottah Lake.
Gerres limbatus. Cochin, backwater (brackish water).

NANDIDÆ—

Nandus marmoratus. Travancore.

GOBIIDÆ—

Gobius giuris. Shasthancottah Lake.

MUGILIDÆ—

Mugil cunnesius. Cochin, backwater (brackish water).

OPHIOCEPHALIDÆ—

Ophiocephalus gachua. Shencottah. Shasthancottah Lake. Kulattupuzha.
,, *striatus.* Shasthancottah Lake.

LABYRINTHICI—

Polyacanthus cupanus. Kerumadi. South end of Vimbanad Lake (slightly brackish water).

CHROMIDES—

Etroplus maculatus. Cochin, backwater (brackish water). Shasthancottah Lake.
,, *suratensis.* Shasthancottah Lake.

None of these species seem to call for special note, but the exact localities may prove interesting.

4. THE INDIAN SPECIES OF THE GENUS *Discognathus.*—*Discognathus* is a widely distributed genus of the subfamily Cyprininæ. It occurs in rivers, especially in mountain streams, in Asia and Africa,[1] and extends throughout India, Ceylon and the Tenasserim provinces.

The difficulty of satisfactorily identifying specimens of the Indian species of this genus according to either Günther[2] or Day[3] induced me to look through the collection in the Indian Museum, with the following results:—

[1] *Cat. of the Freshwater Fishes of Africa*, vol. i, p. 343 *et seq.*, Brit. Mus., 1909.
[2] *Cat. Fish. Brit. Mus.*, vol. vii, p. 69 *et seq.*, 1868.
[3] *Fishes of India*, vol. ii, p. 527 *et seq.*

(1) According to Günther there are three Indian species of *Discognathus*—

Discognathus lamta.
,, *macrochir.*
,, *nasutus.*

(2) According to Day there are also three, *viz.*—

Discognathus lamta.
,, *jerdoni.*
,, *modestus.*

One would, however, not be correct in imagining from this that there are five distinct species of this genus, since Günther, writing in 1868, includes both of Day's species *lamta* and *jerdoni* (1867) in his *lamta.* He says: "Having fortunately numerous examples from the most distant localities, I have convinced myself that they ought to be referred to a single species only."

Apparently the chief points on which Day relies for the separation of *lamta* and *jerdoni* are—

(1) The convexity or concavity of the interorbital space.
(2) Ratio of length of head to total length.
(3) The number of lateral transverse rows of scales, these being $4 \cdot 4\frac{1}{2}$—5 in *lamta* and $4\frac{1}{2}$—$2\frac{1}{2}$ in *jerdoni.*

With regard to the first two points Günther says: "This species (*i.e.*, the *lamta* and *jerdoni* of Day combined) extends from Syria to Assam, and, as may be expected in a species of so wide a range, it is subject to some variation." The points which Günther takes as subject to variation and therefore to be omitted as specific distinctions are just those which Day relies on as affording him firm ground for such separation. Günther writes: "The parts most subject to variation are the snout with regard to form, width and prominence . . . . . and the eye." So that we have to fall back on the third of the above points, which at first sight seems of sufficient importance to justify Day's distinction.

Unfortunately there is no specimen of Day's *Discognathus jerdoni* in the Indian Museum; apparently the only specimens of this form were sent to the British Museum. There is, however, a large number of *D. lamta* here, and in these the number of rows of scales from the lateral line to the ventral fin[1] is $3\frac{1}{2}$ and not 5 as Day states. This number is uniform in a large number of specimens from widely different localities and is the number given for *modestus.*

Discognathus modestus, Day, was first described in 1869 under the name of ***Mayoa modesta***, ***i.e.***, subsequently to the appearance of Günther's work. This so-called species is stated by Day to differ from the others principally in—

[1] For Day's method of counting the L. tr. rows of scales, see *Fauna of India* Fishes, vol. i, p. 6.

(1) Having six rays in the anal fin instead of seven.
(2) Having a lateral transverse formula of $4\frac{1}{2}$—$3\frac{1}{2}$ instead of 4-$4\frac{1}{2}$—5 or $4\frac{1}{2}$—$2\frac{1}{2}$.
(3) The fact that the pectorals extend to the ventrals.

There are at present three specimens in the Indian Museum labelled *D. modestus*. Day in his *Fishes of India* speaks of two, probably from Northern India, the longest measuring $3\frac{1}{2}$ inches. These two specimens are numbered 710 and 1426 in the Museum books, and the latter is that figured in Day's work as *D. modestus* (pl. 122, fig. 5). In both these specimens the number of lateral transverse rows of scales agrees with that given by Day, but as it also agrees with all the other specimens of *lamta*, its value as a specific character is not evident. In both specimens the pectoral does not reach the ventral, and in fact Day's own figure does not agree with his description. The figure is correct in so far as it shows the pectorals not extending to the ventrals. This feature therefore is of no use as a specific distinction. The anal fin ray formula is correctly given as 6 (1—5) but this also is quite commonly the case in *lamta*.

There is unfortunately no type of *jerdoni* left, but Day's figure shows the lateral transverse rows of scales to be $4\frac{1}{2}$—$3\frac{1}{2}$, his description, however, gives $4\frac{1}{2}$—$2\frac{1}{2}$. The figure therefore of *jerdoni* agrees with the description of *modestus*. The figure of *modestus* is not sufficiently clear to enable any comparison to be made. Day's figure for *lamta* shows a lateral transverse formula of $4\frac{1}{2}$—$4\frac{1}{2}$, his description gives 4-$4\frac{1}{2}$—5; but his type shows unquestionably that the real numbers are $4\frac{1}{2}$—$3\frac{1}{2}$.

The only difference between the types of Day's *lamta* and *modestus* is the concavity or convexity found in front of the dorsal fins and leading down towards the head, but as this difference is found in specimens collected at Paresnath (Chota Nagpur) in April, 1909, which are otherwise absolutely identical in form and colour, its value as a specific distinction can be disregarded.

Now while Günther gives his reasons for including Day's species of *lamta* and *jerdoni* together, Day retaliates by including two of Günther's species—namely, *lamta* and *macrochir*—together, without assigning any reasons.

Günther (*op. cit.*, p. 69) admits three Indian species of *Discognathus*, namely, *lamta*, *macrochir* and *nasutus*. As already explained, Günther's *lamta* comprises Day's *lamta* and *jerdoni*. There are no specimens of *macrochir* or *nasutus* in the Indian Museum. *Macrochir* has been described as a species by Günther from two specimens, one from the collection of the East India Company, the other from Griffith's collection, the locality given being Assam.

Nasutus is admitted by Günther to specific rank from McClelland's description of a specimen from the Khassyah Mountains [1] (now known as the Khasi Hills); but both *macrochir*

[1] *Journ. As. Soc. Bengal*, vol. vii, p. 947, tab. 55, figs. 2*a* and *b*.

and *nasutus* are included by Day in his *lamta*. This specimen of McClelland's was described under the name of *Platycara nasuta* and incidentally has only six anal rays, the number which Day gives as distinguishing his *modestus* from *lamta* and *jerdoni*, but which I have already shown to be frequent in *lamta* (of Day). Evidently Day considers McClelland's *D. nasutus* to be really *D. lamta* with the snout constricted, a secondary sexual modification. Consequently the three Indian species of *Discognathus* according to Günther are included by Day in his *lamta*. Now Day gives for *lamta* a very wide distribution, for *jerdoni* and *modestus* on the other hand a very limited one, namely, the Bhavani River at the foot of the Nilgiris for the former and "probably Northern India" for the latter.

In conclusion there are no specimens of *Discognathus* in the Indian Museum which justify me in considering that there is more than one Indian species of this genus, but probably the examination of large numbers of specimens from different districts might lead to the establishment of well-defined varieties.

J. T. JENKINS.

INSECTS.

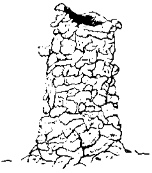
Field Notes on Indian Insects:—

1. THE OCCURRENCE OF THE MYRMECOPHILOUS CRICKET *Myrmecophila quadrispina* IN INDIA.—One evening in July, 1907, I noticed a minute apterous cricket moving about on the top of a wall on the outskirts of Calcutta, surrounded by ants. Although its posterior femora were much thickened, it ran with great swiftness, much in the same manner as an ant. Hav ng secured the cricket and some of the ants, I sent them for identification to the late Colonel Bingham, who returned them shortly before his lamented death, identifying the ant as *Iridomyrmex anceps*, Roger, and saying that Mr. Kirby had compared the cricket with the type of *Myrmecophila quadrispina*, Perkins, and found that it agreed fairly well with that species, with which he regarded it as specifically identical. The cricket was originally described from Hawaii, into which the ant has been introduced by man.

2. CURIOUS HABIT OF AN INDIAN JASSID.—Dr. D. Sharp, in his account of the insects in the *Cambridge Natural History* (vol. vi, p. 577), refers to the "phenomena known as weeping-trees," and states that these phenomena are due to the activities of Homopterous insects of the family Cercopidæ. In India, however, a similar phenomenon is sometimes produced by a common Jassid (*Tetigoniella ferruginea*, Fabr.), although it is not always easy to trace it to its proper source. While collecting insects on Paresnath Hill in Western Bengal last April, I was surprised on more than one occasion to feel what I thought to be rain dripping from a clear sky through the foliage of the trees, until a careful search revealed

the fact that the apparent rain fell directly from the leaves, and was produced by enormous numbers of Jassidæ settled on their lower surface. All these Jassids belonged to the species named; they were fully adult and existed in countless numbers on shrubs and trees of all kinds. A favourite tree was the common fig *Ficus cunia*. Each insect sat with its proboscis buried in the substance of the leaf, to the lower surface of which it clung, and apparently sucked in the sap, for at regular intervals (roughly three minutes) several drops of a honey-like liquid was squirted with some force from the tip of its abdomen. The number of individuals was sufficiently great to give rise to the phenomenon described, but they did not appear to be in any way banded together and took flight in all directions on the slightest disturbance.

3. THE NEST OF THE BEE *Podalirius pulcherrimus*.—During a short collecting trip in the Western Himalayas round Simla at the beginning of May, 1907, I noticed that a hard clay bank near the bungalow at Matiana (28 miles north-east of Simla) was riddled with round holes about 20 mm. in diameter. Some of these holes were surmounted by small turrets of rough clay pellets of various shapes and sizes, the turrets being about 30 to 40 mm. in height. Bees were constantly entering and emerging from the tops of the turrets, and the holes were obviously their burrows. Each burrow ended at a depth of a few inches, after one or more turns, in a small oval chamber, the base of which was lined with pollen kneaded into a paste. No eggs were found, but probably the time for oviposition had not yet come. The bees were identified for me by the late Col. Bingham as *Podalirius pulcherrimus*. Most of the turrets were washed away by a shower of rain during the night, and the bees made no attempt to rebuild them; indeed they probably would have been unable to do so without making fresh excavations. Owing to the direction in which the burrows opened, however, the rain did not enter them to any great extent. The figure has been drawn from a specimen in the collection of the Indian Museum that has been preserved by means of glue.



Entrance to nest of *Podalirius pulcherrimus*.

N. ANNANDALE.

XIPHOSURA.

THE HABITS OF INDIAN KING CRABS.—Two somewhat variable species of King Crab (*Limulus moluccanus* and *L.* (*Carcinoscorpius*) *rotundicauda*) are common in Indian waters; but little information is available as regards their habits, which seem to differ considerably from those of the Japanese and American forms. Observations made in 1901 on the east coast of the Malay Peninsula and recently

in Bengal show that whereas *L. moluccanus* is essentially a marine species, occurring on sandy and muddy bottoms from the tide-line to a depth of 20 fathoms, *L. rotundicauda* is mainly if not entirely estuarine. It ascends the river Hughli at least as far as Calcutta, that is to say, for a distance of about 90 miles from the open sea, and can live in water that is practically fresh. On the coast of Bengal *L. moluccanus* breeds at the end of the cold weather, *i.e.*, in March. The eggs, which are not very numerous, have a green colour and measure about 3 mm. in diameter, are carried on the ventral surface of the abdominal appendages, to which they adhere lightly. Further information as regards the habits of the Indian *Limuli* would be of interest.

N. ANNANDALE.

CRUSTACEA.

THE RATE OF GROWTH IN *Conchoderma* AND *Lepas.*—Dr. J. T. Jenkins has given me the information on which the following note is based; it is of interest as illustrating the relative rate of growth in two species of barnacles. A clean buoy was placed in the sea off the coast of Ganjam, on February 23rd, 1909, by the Fisheries Steamer "Golden Crown," and was lifted on March 3rd. Numerous specimens of *Lepas anserifera* and *Conchoderma virgatum* var. *hunteri* were found adhering to it. Those of the former species were all small, the largest having a capitulum 8 mm. ong, whereas it is usually about 20 mm. long in fully grown examples of the species from the Bay of Bengal. The specimens of *C. virgatum* var. *hunteri* were, however, much larger, and appeared to be already adult. The capitulum of the largest measured 15 mm. in length. This individual is actually the largest specimen of the variety I have seen, although it had reached this size in eight days from that on which the larva probably settled. It is of interest to note, therefore, that the rate of growth in *C. virgatum* var. *hunteri* is considerably greater even than it is in the common *L. anserifera*. It may be noted that whereas the latter species is usually found attached to inanimate objects, *C. virgatum* var. *hunteri* is frequently taken on the skin of turtles and sea-snakes.

N. ANNANDALE.

POLYZOA.

LARGE COLONIES OF *Hislopia lacustris.*—In volume i (page 177) of the *Records of the Indian Museum*, I described the two forms of colonies of *Hislopia* that I had found in the United Provinces (Bulandshahr). Of these, one was a more or less linear arrangement of the zoœcia on leaves and twigs, and the other, and more common, form was an encrusting sheath on the outer surface of the shells of *Paludina*. During the present "rains" (July 1908) I have found many examples of what may be considered a much exaggerated extension of the latter form. These colonies

have been on bricks, tiles and other submerged objects. The largest colony that I have seen so far was on a tile; one side of the tile was exposed above the mud of the bottom of the tank, and its area measured about 120 square inches: the entire surface was almost completely covered by a continuous growth of *Hislopia*. Another large colony was on a piece of bark which measured 7 inches by 3 inches: both sides were practically everywhere covered by *Hislopia*.

These specimens suggest that, within reasonable limits, the size a colony may attain is only determined by that of the object on which it grows.

In these giant colonies the zoœcia are somewhat compressed: the typical oval shape is in a measure lost, and they become somewhat polygonal or circular and are of comparatively small size.

The rainy season is evidently the time at which the growth of *Hislopia* is at its maximum. The particular tank from which I have obtained most of my specimens has been kept full of water all through the hot weather; the exuberant growth of *Hislopia* during the "rains" cannot, therefore, in this case be attributed to a larger area being available at this season.

Now as usual almost every *Paludina* in the tank, except quite small ones, is covered with *Hislopia*, and in this situation the zoœcia retain their oval form.

H. J. WALTON.

CŒLENTERATES.

Branchiocerianthus imperator VON DER KÜSTE VON OMAN UND BALUCHISTAN.—Wie aus einer kurzen Notiz von R. E. Lloyd (s. *Rec. Ind. Mus.*, vol. i, p. 1-2, 1907) bekannt ist, wurde der bilateral symmetrische *Branchiocerianthus imperator* im Jahre 1906 durch den "Investigator" (1) an der Küste von Oman, nahe dem östlichsten Punkt Arabiens unter 21° 49′ 50″ N. Lat. und 59° 48′ 0″ E. Long., und (2) an der Küste von Baluchistan unter 24° 45′ 0″ N. Lat. und 63° 50′ 15″ E. Long. aus 900 Meter (492 Fath.), resp. 995 Meter (544 Fath.) gedredgt. Durch die grosse Liebenswürdigkeit von Dr. Annandale in Calcutta ist es mir möglich gewesen, beiderlei Material zu untersuchen.

Dies Material hat deshalb ein besonderes Interesse, weil hier zum ersten Male ganz jugendliche Exemplare von *Branchiocerianthus* vorliegen, und weil diese von den bisherigen Fundorten (Japan, Nördl. Pacific, Golf von Panama und Ostafrika) so entfernte Lokalität über die geographische Verbreitung des Genus ganz neue Perspektiven eröffnet. Leider sind sämtliche Exemplare sehr schlecht erhalten, offenbar auch nur in starkem Alkohol conserviert, sodass sie stark geschrumpft und sehr hart und brüchig geworden sind. Das Material besteht aus 10 Exemplaren von Baluchistan, deren Grösse zwischen 60 und 120 mm. schwankt, und 1 Exemplar

von der Oman-Küste von 160 mm. Länge. Die Bilateralität ist bei allen *sehr* deutlich; der Hydrocaulus sitzt der Mundscheibe *sehr* excentrischen, so dass sie darin eine vollkommene Übereinstimmung speciell mit *Branchioceriantlhus imperator* (Allm.) zeigen; denn bei *B. urceolus* Mark sitzt der Hydrocaulus an der Mundscheibe noch nahezu Central. Blastostyle und Radiärkanäle sind nirgends mit Sicherkeit zu erkennen, was indessen seinen Grund wohl mir in dem schlechten Erhaltungszustand hat. Die aboralen Tentakel sind je nach der Grösse des Hydranthen 20 bis 30 mm. lang. Das Diaphragma an der Grenze von Hydrocaulus und Hydranth ist an einigen Exemplaren nachweisbar. Die lederartig straffe Stützlamelle des Hydrocaulus gleichtvollständig der an den Exemplaren des "Challenger" und denen, die Prof. Doflein im Jahre 1904 im der Sagamibai (Japan) gefischt hat.

Ein dichter Wurzelschopf fehlt an sämtlichen Stücken von Baluchistan; es machte mir aber den Eindruck, als ob die Wurzelscheide mit dem an ihr sitzenden Wurzelschopf überall, wohl beim Herausreissen aus dem Boden, abgestreift war. Dagegen war der Wurzelschopf bei dem Exemplar von der Oman-Küste in der charakteristischen Form vorzüglich ausgebildet. Im Ganzen scheint es mir durchaus möglich, dies Material, obwohl es sich nicht auf Einzelheiten prüfen und vergleichen liess, als *Branchioceriauthus imperator* (Allman) zu bezeichnen.

Sämtliche Exemplare, besonders die von Baluchistan, sind noch sehr jung. Da aber auch sie schon die charakteristische excentrische Ansatzstelle des Hydrocaulus am Hydranthen zeigen, so wird die frühere Vermutung hinfällig dass diese Bilateralität erst im Laüfe des Lebens durch ungleichmässiges Wachstum entstünde. Der Hydranth wird vielmehr von vornherein bilateral angelegt.

Ein Vergleich sämtlicher bisher bekannten Exemplare von *Branchioceriauthus* und eine Zusammenstellung von allem, was wir bisher über dies Genus wissen, erscheint in den *Beiträgen zur Naturgeschichte Ostasiens*, herausgegeben von F. Doflein. E. Stechow, "Hydroidpolypen der japanischen Ostküste." München, 1909.

E. Stechow,

München.

XXIV. DESCRIPTION OF A MINUTE HYMENOPTEROUS INSECT FROM CALCUTTA.

By N. ANNANDALE, *D.Sc., Superintendent, Indian Museum.*

On August 25th while I was examining some microscopic specimens in oil of cloves, a minute insect appeared in the field of vision, having fallen into the oil as minute insects often do. An examination showed that this little animal, which is perhaps the smallest insect yet known, belonged to the family Myrmaridæ and was related to the species described and figured by Westwood [1] as *Alaptus excisus.* I have therefore ventured to describe it as the type of a new species of the same genus, for it is unlikely that it will be discovered by any professed student of the Hymenoptera, or, indeed, by anyone not engaged in microscopical work in India.

Alaptus magnanimus, sp. nov. (Plate xxiii.)

Size very minute (length 0·21 mm.; expanse, including wing fringe, 0·85 mm.).

Head viewed from above short and broad, the anterior margin appearing truncate owing to the fact that the anterior face is vertical; viewed from in front deep. Antennæ minutely hairy, with nine joints (in the ♂); the basal joint subcylindrical, tapering slightly at the tip, bending upwards and outwards from its point of origin, which is situated far forward on the head; second joint much shorter, pear-shaped, with the narrow end proximal; third and fourth joints subcylindrical, the latter much the shortest in the antenna; the other joints (fifth to ninth) pear-shaped, narrower at the base than at the tip, gradually increasing in size. Eyes large, elongately oval, separated by more than their own transverse diameter, curved when viewed from the side. Three ocelli, one close to the inner margin of each eye and one in the middle of the vertex; a minute bristle in front of each of the lateral ocelli. (The mouth parts are not visible in the type.)

Thorax.—Pronotum transverse, angulate, almost linear, produced at either side and bearing at the tip of the projection a bunch of minute hairs. Mesothorax much longer, transversely lozenge-shaped but with the posterior angle replaced by a broad concavity. Scutellum narrow, especially in front; the anterior margin depressedly convex forwards; a single bristle on either

[1] *Trans. Linn. Soc. Lond.*, Zool. (2), vol. i, p. 586, pl. lxxiii, figs. 10, 11 (1879).

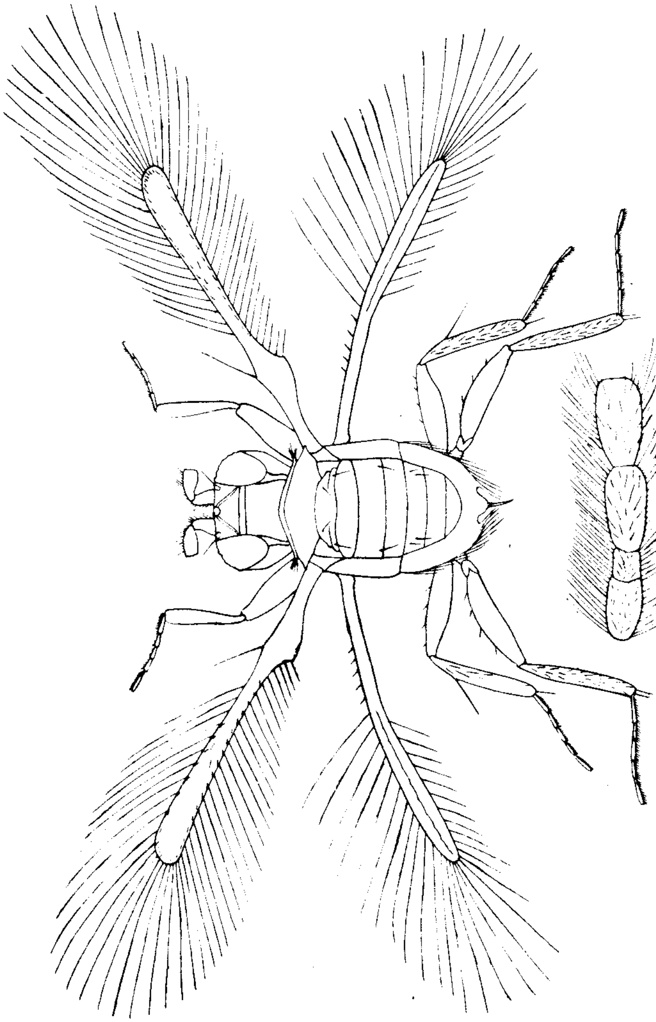
side of the disk near its centre. Postscutellum imperfectly separated, transverse, band-like, with a single bristle on either side. Metanotum large, transverse, with the anterior margin sinuous and the posterior convex. (The ventral surface and the sides are concealed in the type.)

Wings.—Fore wings long and slender with the tip obliquely rounded; the base very narrow, becoming somewhat dilated just behind the point at which the marginal fringe commences on the posterior margin. The hairs that form this fringe numbering about 45, long and slender, becoming shorter towards the base of the wing on both margins, the longest (at the tip) being rather less than half as long as the wing without the fringe; within the fringe, near the edge of the wing, a row of minute bristles, and two similar bristles near the centre of the disk; on the anterior surface a single long bristle at the widest part of the wing. Posterior wing almost linear, very little dilated distally; the tip narrowly rounded; the fringe without an inner row of bristles, consisting on the anterior margin of 5 short hairs followed, distally, by about 20 long ones, and on the posterior margin of about 11 moderate hairs, which are only a little longer at the distal end than towards the base; the basal half of the posterior margin bare; a minutely serrated ridge runs down the middle of the distal half of the wing.

Legs moderately long, with the femora, tibiæ and tarsi subequal; the tarsi minutely hairy, consisting of 5 subequal joints and bearing two minute claws at the tip. The tibiæ of the middle and hind legs clothed with minute recumbent hairs and bearing a pair of small bristles at the tip; those of the middle legs bearing a single, longer bristle on the anterior surface.

Abdomen (♂) stout and rounded; the sides clothed with scale-like hairs; the first dorsal segment bearing a single bristle on either side near the posterior margin; the penultimate segment with a pair of unequal bristles on either side, the longer bristle being posterior to and nearer the middle of the segment than the shorter one.

Remarks.—As the specimen was not discovered until it had fallen into clove oil, which had rendered it partially transparent, I cannot describe its coloration in detail. The head (including the antennæ), the thorax and the abdomen appear, however, to have been dark in colour, and the limbs pale. The wing fringes have evidently been dark also, and it is just possible to detect a faint white band running round those of the fore wings at a short distance from the base of the hairs. Unfortunately both antennæ were broken in mounting the specimen, but notes were taken on their structure before this occurred. In the type (Reg. No. $\frac{2592}{16}$ of the Indian Museum insect register), which is mounted on a glass slide for microscopic examination, only the first two joints remain *in situ*, with the third to sixth joints of one antenna free. Except the left fore wing, the wings have also become separated, but all are preserved.



Alaptus magnanimus. ♂, × 240, with the third to sixth joints of the antenna more highly magnified.

XXV. THE INSECT FAUNA OF TIRHUT.

I.—RHYNCHOTA HETEROPTERA.

By H. MAXWELL-LEFROY, *M.A., F.E.S., F.Z.S.,*
Imperial Entomologist.

INTRODUCTION.

In another place (*Indian Insect Life*) I have discussed the general difference there is between the insect fauna of tropical India, and that of the sub-tropical moist hill slopes. I have also indicated the faunal zones of India as I believe they occur with regard to insects. In this memoir, a beginning is being made to elaborate these subjects, first by enumerating the insect fauna of a place lying well within the tropical area, secondly by contrasting that fauna, as far as may be, with neighbouring tropical areas and by discussing its origin. As is abundantly clear from a perusal of the localities in the "Fauna of India," nearly all the species are from sub-tropical or temperate places, very few from tropical India. The localities in the "Fauna" volnmes do not, except in such as have been published so recently as to include our collections, enable us to contrast the tropical and sub-tropical faunæ; but the enumeration of the fauna of one spot, very carefully worked for a series of years, will afford some data.

The regional faunæ of India are, except in Lepidoptera, very little known; a compiled list of the fauna of one place (with other records of occurrence in tropical localities) will therefore be of permanent value; we have the material for all orders; we hope to do the Aculeate Hymenoptera, Coleoptera, Lepidoptera and Rhynchota Homoptera; we also hope to do the remaining orders, when we have secured the co-operation of systematists in working out onr collections.

In this memoir, I enumerate the Heteropterous fauna of Pusa, following the order of the volumes on Rhynchota, by W. L. Distant, in the "Fauna of India"; I give other localities from which specimens have been collected and are in the Pusa collections, giving dates of capture where possible. I have included species found at Chapra by Mr. M. Mackenzie where we have not found them, as Chapra lies in the same area. Pusa lies in the "Gangetic Plain, West," north of the Ganges, in the Tirhut division of Bengal; it is at a distance of over 50 miles from the Himalayas, and so is well removed from any sub-tropical area; it lies nearly 40 miles north of the Ganges, and is in a flat, densely cultivated tract which should have a uniform fauna (see *Indian Insect Life*, page 25).

PENTATOMIDÆ.

PLATASPIDINÆ.

1. *Brachyplatys pauper*, Voll.

Pusa. 3-viii-05—11-viii-05—23-vii-05.
Podanur, Madras. 30-vii-07.
Khasi Hills. iv-07.

The Fauna gives Ceylon, Andamans, and the Malay Archipelago. It is clearly not a sub-tropical species, but a well-marked tropical one probably.

2. *Brachyplatys subaëneus*, Westw.

Pusa. 2-viii-05—26-vi-07—vii-08.

The Fauna gives this a wide distribution; it is known, for instance, from Mungphu and Calcutta, though not from any other place in the Himalayas. It would probably be a Malayan or Indo-Chinese species, penetrated up through Bengal and essentially tropical.

3. *Coptosoma cribrarium*, Fabr.

Pusa. 14-v-05—23-vi-07—vii-06.
Surat. 15-xii-03.
Muzaffarpur. 19-xi-04.
Ranchi. xi-06.
Nadiad. 6-xii-03.
Mahim. 22-ii-04.
Jalalpur. 7-v-04.
Jullundur. 19-vii-05.

The Fauna gives Calcutta, Bombay, Barwai, Burhanpur, Bangalore, Nilgiris, Nagas, Burma, China, Formosa.

In India, a very common tropical species, clearly not originating in sub-tropical India. Its season for activity and breeding is July to October as a rule, but the imago lives over and is captured at all times.

4. *Coptosoma siamicum*, Wlk.

Pusa. 16-vi-05—22-vii-05—2-viii-05—23-xi-04—1-xii-06—2-ix-07, etc.
Dacca. 13-i-06.
Bombay. x-05.
Raniganj. iii-06.
Surat. 10-vi-04.

The Fauna gives Calcutta, Barwai, Ceylon, Burma, etc. It is apparently a tropical species originating in Malaya or Weddaland.

5. *Coptosoma indicum*, Leth.

Pusa. 19-ix-06.
Palamau. ix-06.

So small as to escape notice. The Fauna gives Ceylon and Siam.

If the species of the sub-family occurring in Sikhim or the Western Himalayas are listed, it will be seen that there are ten species, not known from Pusa, occurring there.

SCUTELLERINÆ.

6. *Cantao ocellatus*, Thunb.

Pusa. 13-xi-05—8-vii-07—13-xi-05—5-vi-07.
Rangpur. 23-vii-05.
Nilgiris. 7,000 feet. 2-v-04.
Khasis. 4,000 feet. v-05.
Not a common species in the plains ; essentially a tree insect.

The Fauna gives tropical and sub-tropical localities, and it occurs more abundantly in the latter, where its food is more plentiful.

7. *Scutellera nobilis*, Fabr.

Pusa. 20-iii-07—1-vii-08—24-vii-06—31-vii-05—6-viii-08.
Gojra (Punjab). 11-vii-06.
The Fauna localities are essentially tropical also.

8. *Chrysocoris stollii*, Wolff.

Pusa. 8-vi-05.
Tribeni. 23-iii-05.
Buxar Duars. v-07.
Matheran. iv-08.
Chindwara. 21-iv-08.

The Fauna localities are tropical and sub-tropical, and the species has probably spread up from Malaya.

9. *Chrysocoris patricius*, Wlk.

Pusa. xii-04.
Chapra. x-04.
Cawnpore. 14-x-05.
Dehra Dun. ix-06.
Raipur, C. P. vi-07.
A small species found on rice.

The Fauna gives Ceylon, Manipur, Khasis and Burma. A tropical species.

10. *Hotea curculionoides*, Herr.-Schäff.

Pusa. 3-xii-04—8-vi-05—17-i-05—22-i-05.
Nongpoh, Khasis. 2,000 feet. vii-07.
A rare species found singly on the surface of the soil, etc.

Given in the Fauna as Khasis and Nagas, Burma, Ceylon, Malay Peninsula, etc. Derived probably from Malaya.

11. *Arctocoris incisus*, Stål.

Pusa. 26-vi-08.

A very rare species, that occurs apparently just as an example of how little we *really* do know of our fauna.

The *Fauna* gives "Bengal," probably North-West India or Himalayas.

There are thirteen species, occurring in the Himalayas nearest to Pusa not found in Pusa and, as before, the species found occur more in Malaya than elsewhere.

GRAPHOSOMATINÆ.

12. *Podops coarctata*, Fabr.

Pusa. 6-i-05.
Salem, Madras. 14-viii-07.
Baroma, Kamrup. 2-iii-07.
Helem, Assam.

A widely spread tropical species, the Fauna giving Tranquebar, Ceylon, Burma, Malay Peninsula and Java.

13. *Podops dentata*, Dist.

Pusa. vi-07.
The Fauna gives only Calcutta and Malda.

14. *Podops limosa*, Wlk.

Pusa. vi-07.
The Fauna gives Calcutta, Tenasserim.

15. *Storthecoris nigriceps*, Horv.

Pusa. 17-ii-05—8-vi-08—vii-08—7-iii-08.

Comes freely to light in June, July; is found abundantly in soil during January and February.

The Fauna gives only Khasi Hills and Sibsagar.

16. *Amauropepla denticulata*, Hagl.

Pusa. 6 to 13-ii-05. Found in soil.
Elsewhere known only from Assam and Burma.

17. *Melanophara spinifera*, Westw.

Pusa. 3-ii-05.
Like the others, found in soil in the cold weather.
The Fauna gives Bengal, Calcutta and Penang.

This sub-family is not well represented in the Himalayas, *Podops serrata*, Voll., being the only species in Sikhim; it is not in our fauna, which is essentially tropical and originate in Burma or Malaya.

CYDNINÆ.

18. *Stibaropus molginus*, Schiödte.

Pusa. 5-vii-07.
Mokameh. x-06.

This species is extremely abundant at the Ganges, for instance on the Mokameh ferry steamer at night at the arc lights.

The Fanna only records North India and Burma.

19. *Stibaropus callidus*, Schiödte.

Pusa. 15-vi-09—15-vii-07.
Sitamarhi. 15-i-05.
Muzaffarpur. 1-x-04.

Is found in soil in winter. Is sometimes extremely abundant, after rain, at light. Nymphs are found deep in the soil.

The Fauna records Serampore, Calcutta, South India, Burma.

20. *Stibaropus minor*, Wlk.

Pusa. 15-vi-09.
Mokameh. x-06.
Chapra (Mackenzie).

Recorded in the Fauna from North India and Burma.

21. *Lactistes rastellus*, Schiödte.

Pusa. vii-07.
Rampur Boalia. 28-ii-07.

The Fauna records it from Serampore, Burma, Tenasserim, Philippines.

22. *Cydnus indicus*, Westw.

Pusa.—Abnndant from June to September, after rain, at light. Found in concealment in soil, fallen leaves, etc., all the winter.

Surat. 20-i-04—September, abundant.
Somastipur. 16-i-05.
Janakpur. 10-i-05.
Raniganj. iii-06.
Kasauli. 6-ii-08.
Shoranur. 31-vii-07.

The Fauna gives Bombay, Burma,—also South Africa, Madagascar, Malay Archipelago, Australia. This is the notorious "Gundy" of India, which comes to light in such immense and irritating profusion. All the records, except Kasauli, are of tropical localities.

23. *Cydnus nigritus*, Fabr.

Pusa. 12-vi-06—1-vii-08.
Cuttack. vi-05.
Jorhat. vi-07.
The Fauna gives Burma, Eastern Europe, Cochin China, China and Japan.

24. *Cydnus varians*, Fabr.

Pusa. 8-vi-07—13-vii-06—6-ii-06.
The Fauna records Bengal, Bombay, Ceylon, Burma, Tenasserim.

25. *Macroscytus subaëneus*, Dall.

Pusa. 24-i-06—22-vi-06.
Buxar Duars. v-07.
The Fauna records Bombay, Deccan, Burma, Tenasserim, the Malay Archipelago, Japan.

26. *Geotomus pygmæus*, Dall.

Pusa.—Abundant in July, August, September. 25-ii-08—v-08.
Palamau. ix-06.
Muzaffarpur. 18-x-04.
Surat. 2-x-04.
The Fauna records Bombay, Ceylon, Burma, Malay Archipelago, China, Japan, Hawaii, New Caledonia.

27. *Brachypelta aterrima*, Forst.

Pusa.—Found from February to April, in each year, in the ripening crops. Appears to be a cold weather species, active only then.

The Fauna records Hardwar and Bombay; common in the Palæarctic Region, abundant in North Africa, Queensland. I should class this with the "cold weather species" of Palæarctic origin, which have wandered in and are active only in our cold weather and just after. More of this class follow.

28. *Chilocoris nitidus*, Mayr.

Pusa. 17-vii-08.
The Fauna records Kashmir and Japan.

This sub-family is very little represented in Himalayan subtropical localities, so far as the records show. Our fauna is largely Malayan and tropical, with one marked Palæarctic immigrant.

PENTATOMINÆ.

29. *Halys dentatus*, Fabr.

Pusa.—All months.
Poona. 12-xi-03.
Cuttack. xi-05.
Palamau. 7-ix-06.
Bombay. 20-iii-05.
Surat. 12-vi-04.
Amraoti. 15-iii-04.
Katni. ii-07.
Ranchi. xi-06.
Dacca. i-06.

The Fauna gives a wide distribution in tropical and sub-tropical India. This insect is found on tree trunks, on or under the bark.

30. *Laprius varicornis*, Dall.

Pusa. 12-vi-08—30-vii-08.
Surat. 8-viii-04.
Katni. ii-07.
Khasis. ?

The Fauna gives Sind, Khasis, Cochin, Calcutta, Bombay.
The species appears to be almost confined to tropical India.

31. *Æliomorpha lineaticollis*, Westw.

Pusa. 3-xi-05—27-vi-06—2-ix-07—2-iv-07.
Bombay. 14-iv-05.
Palamau. ix-06.
Ranchi. xi-06.
Balaghat. iii-07.
Munshiganj. 21-i-06.

The Fauna gives Bengal and Bor Ghat. A tropical species apparently.

32. *Adria parvula*, Dist.

Pusa. vii-08.
Cawnpore. 16-x-05.
Purulia. xi-06.
Surat. 8-vii-04—1-vi-04—1-xii-03—7-viii-04—26-xi-03—24-v-04—5-iii-04.
Palamau. ix-07.

The Fauna records Ranchi, Khandala and Burma. This distribution would point to the tropical areas and the sub-tropical hill areas they enclose (*i.e.*, exclusive of Himalayas, Assam, etc.).

33. *Mecidea indica*, Dall.

Pusa. 27-v-06—26-vi-06.
Lyallpur.

The Fauna gives Bombay and Poona. This insect is fairly conspicuous and if it occurred in the Himalayas would probably have been found.

34. *Ænaria elongata*, Dall.

Chapra (Mackenzie).

The Fauna records North India, Burma, Tenasserim, Philippines.

35. *Halyomorpha picus*, Fabr.

Pusa. 11-vi-06.

The Fauna gives a wide distribution, including the Khasis, Calcutta, Burma: "a common species throughout Malaysia and found in China and Japan."

36. *Dolycoris indicus*, Stål.

Pusa.—Very commonly found from February to May. Found sparingly for rest of year.

Palamau. 30-ix-06.

Lahore. 20-iv-07.

The Fauna gives Naga Hills, Darjiling, Bombay, Deccan, Bangalore, Calcutta.

Probably universal in tropical India; it is a species that lives on green herbage and is easily confused with *Agonoscelis nubila*. The closely similar *Dolycoris baccarum*, Linn., does not appear to occur at Pusa.

37. *Æschrocoris tuberculatus*, Stål.

Pusa. 16-x-06—19-viii-08.

The Fauna records Sikhim, Garo and Naga Hills, Burma. A rare species in Pusa.

38. *Eusarcocoris guttiger*, Thunb.

Pusa. 18-iii-05—23-iv-07—19-v-05—9-iv-06—2-vii-06—vii-08—24-xii-04.

Surat. 24-v-04.

Belgaum. iv-08.

Simla. x-06.

Muzaffarpur. 12-x-04.

Dacca. 10-i-06.

Balaghat. iii-07.

Chapra. 20-x-04.

Nasik. 26-ii-04.

The Fauna records Sikhim, Naga Hills, Bombay, Calcutta, Ceylon, Burma, Tenasserim, China, Japan; a widespread species in tropical and sub-tropical India.

39. *Eusarcocoris ventralis*, Westw.

Pusa. 3-iii-05—30-ix-06—x-06—28-xi-04—10-iv-07—8-xi-05—viii-04.

Chapra. 20-x-04.

Muzaffarpur. 15-x-04.

Surat. 19-viii-04—17-i-04.

Khasis. 17-iii-07.

The Fauna includes Calcutta, Bangalore, Ranchi, Bombay, Burma, Malay Peninsula.

This is a tropical species; compare with *E. montivagus*, Dist., the very distinct hill form of the Himalayas, found from Assam hills to Mussoorie.

40. *Eusarcocoris dubius*, Dall.

Pusa. 29-ix-06—12-viii-05—21-ix-08.

The Fauna records Tenasserim and Berhampore (? in Bengal).

I am a little doubtful of the identification but believe all mine to be this tropical species.

41. *Plautia fimbriata*, Fabr.

Pusa. 26-iii-06—27-v-06—14-vi-06—5-vi-07—30-vii-08—4-vii-07.

Surat. 26-i-04.

Arrah. 19-iii-08.

In the Fauna, a wide tropical and sub-tropical distribution in India, and also in Malaya, China and Japan. The Pusa dates imply nothing more than the fact that, like other bugs found on plants, they are commonly caught in those months because all crowd on to the small irrigated crops and are seen, when they are unnoticed later in the more abundant herbage.

42. *Antestia cruciata*, Fabr.

Pusa. 18-iii-06.

Nagpur. 6-vi-05.

Kasauli. 6-v-08.

Matheran. iv-08.

Igatpuri. iii-08.

Nilgiris. vii-05.

The Fauna records Sikhim, Calcutta, Bombay, Nilgiris, Ceylon, Tenasserim, Malay Archipelago.

A species well known to feed on fruit, peaches, plums and coffee-berries; it is an abundant sub-tropical species, but is found sporadically in the plains; possibly the occurrence of fruit orchards or wild fruiting bushes such as bér (*Zizyphus jujuba*) affect its occurrence.

43. *Apines concinna*, Dall.

Pusa. i-v-07—vi-07.

The Fauna gives Hardwar, Bombay. A rare tropical species.

44. *Agonoscelis nubila*, Fabr.

Pusa.—General throughout the year and extremely abundant on all green herbage and plants such as jute, maize, etc. Sometimes sucks forming grain.

Purulia. xi-06.
Jorhat. v-07.
Balaghat. iii-07.
Dacca. 10-i-06.
Munshiganj. 17-1-06.
Sitamarhi. 15-i-05.
Nilgiris. 7,000 feet. v-04.
Chapra. x-04.

The Fauna records it over a wide area from Kashmir to Bombay and Burma, Malay Peninsnla, China, Japan: a tropical and subtropical species.

45. *Eurydema pulchrum*, Westw.

Pusa. 3-iv-05—12-iv-06—27-iii-06—18-v-06.
Khasis.

In the Fauna, is given as a sub-tropical species. Possibly an immigrant from sub-tropical Himalayas.

46. *Bagrada picta*, Fabr.

Pusa.—In all years, very common on ripening mustard, rape and allied crops in February, March, as on cabbage and similar *Cruciferæ*.

The Fauna gives Hardwar, Tirhut, Calcutta, Manipur, Bombay, Ceylon.

It is common in the Konkan, the Deccan, Central Provinces, United Provinces, and a small form is common at Lebong. Essentially a "cold weather species," not possibly from climatic causes so much as that its food plants enable it to breed then.

47. *Placosternum taurus*, Fabr.

Pusa. 1-vii-05.
Mussoorie. viii-06.
Yercaud.

The Fauna records it as a hill species from Sikhim, N. Khasis, Cochin and Burma. It is rare in Pusa and may have been a chance immigrant, as it is a very conspicuous form.

48. *Catacanthus incarnatus*, Dru.

Pusa. 9-vi-05—1-v-08.
Mahim. 22-ii-04.
Khasis.
Poona. 19-vi-05.
Kanara. viii-07.

The Fauna gives it a wide spread in the hills, but also includes Calcutta, Karachi, Bombay, Pondicherry.

It is a Malay Archipelago species, also from Japan and Korea.

It is the most conspicuous tropical form and is, in the plains, rare.

49. *Nezara viridula*, Linn.

Pusa.—In all months.
Surat. 2-iv-04—7-ii-04—18-xii-03.
Coonoor. 17-iv-04.
? Shevaroys. viii-07.
Coimbatore. 27-vii-07.
Bilaspur. ii-07.
Ranchi. x-06.
Purulia. xi-06.

The Fauna records all India, and almost the whole world. A tropical, sub-tropical and temperate species.

50. *Piezodorus rubrofasciatus*, Fabr.

Pusa.—All months.
Bilaspur. ii-07.
Katni. ii-07.
Surat. 18-xii-07—21-i-04.
Bassein. 23-xii-03.
Nadiad. 5-xii-03.
Burdwan. ii-05.

The Fauna records Sikhim, Assam, Bengal, Bor Ghât, Ceylon, Upper Burma, Malaya, Japan, Australia.

A well-established tropical and sub-tropical species, found abundantly on low vegetation.

51. *Menida histrio*, Fabr.

Pusa. 1-ix-04.
Chapra. 30-x-04.
Cuttack. 23-xi-05.
Dacca. 19-i-06.

The Fauna gives Calcutta, Bangalore, Burma, China, Formosa. A tropical species, as opposed to the sub-tropical *M. varipennis*, Westw., and *M. formosa*, Westw.

In this sub-family we have twenty-three species in our fauna, while there are at least forty sub-tropical species known from our nearest sub-tropical area that are not known from Pusa, though we have specimens of most of them in the collection and could recognise them. Our fauna here is essentially tropical.

AMYOTEINÆ (ASOPINÆ).

52. *Cazirà verrucosa*, Westw.

Pusa. 19-vi-06.
Khasis. vii-07.
Nilgiris. v-06.

Calcutta is the only tropical locality given in the Fauna. It is a sub-tropical species apparently.

53. *Cazira ulcerata*, Herr.-Schäff.

Pusa. 31-viii-05—21-iv-06.

The Fauna gives Sikhim, Calcutta, Coromandel, Siam and Hong-Kong.

54. *Canthecona furcellata*, Wolff.

Pusa.—All months.
Daltonganj. viii-05.
Lebong. ix-08.

A widespread species, wholly predaceous on caterpillars and breeding when these are abundant.

The Fauna records are tropical mainly. It probably occurs throughout tropical India.

55. *Canthecona parva*, Dist.

Chapra.
Daltonganj. viii-05.
The Fauna records Bengal and Mysore.

56. *Picromerus griseus*, Dall. (*obtusus*, Wlk.).

Pusa. 17-vii-05.
The Fauna records only Sikhim, Nagas, Burma.

57. *Andrallus (Audinctia) spinidens*, Fabr.

Pusa. 22-ii-07—18-iv-07—14-vi-06—23-v-05—vi-07—27-viii-08—13-x-07—1-xi-08.
Lebong. ix-08.
Nagpur.

The Fauna records Sikhim, Assam, Khasis, Ranchi, Bangalore. It is probably common over part of the tropical plains; outside India, it is in the Malay Archipelago, Fiji, Tahiti, etc.

58. *Amyotea (Asopus) malabaricus*, Fabr.

Pusa. 10-x-08.
Nagpur. 24-vi-06.

The Fauna records Bengal, Calcutta, Bombay, Bangalore, Assam, Burma, Java, Borneo, Sumatra and the Philippines.

It is not a common species in Pusa.

59. *Zicrona cærulea*, Linn.

Pusa. 3-iv-05—18-ix-08—17-viii-08.
Mussoorie. viii-07.
Chandpur. i-08.

The Fauna gives Kashmir, Bengal, Naga Hills, Burma, Japan, China, Malaya and the Palæarctic Region. Its distribution may be determined by that of its food, *Haltica cyanea*, etc.

In this sub-family, nearly all the species of neighbouring areas are found here, even if only sparsely.

TESSARATOMINÆ.

Of the dozen species found in the Himalayas, not one has been found in Tirhut. The sub-family is markedly sub-tropical, with not one tropical species.

DINIDORINÆ.

60. *Aspongopus janus*, Fabr.

Pusa. 25-i-06—iv-07—31-v-05—22-vi-05—5-vii-05—viii-07—7-x-06.
Sawan. 4-x-06.
Surat. 8-vii-04.
Somastipur. 15-ii-05.
Muzaffarpur. 8-x-04.
Daltonganj. vii-05.

The Fauna records tropical and sub-tropical localities in India, also Ceylon and Burma.

61. *Aspongopus obscurus*, Fabr.

Pusa. 12-vii-07—27-vi-07—20-ii-08—9-ix-07.
Ranchi. xi-06.
Jorhat. v-07.
Daltonganj. viii-05.
Sawan. 4-x-06.
Rungpur.
Siripur. 18-viii-05.
Helem. viii-08.
Khasis. vii-07.

The Fauna records Assam, Bombay, Calcutta and Bangalore. A tropical form.

PHYLLOCEPHALINÆ.

62. *Schizops insignis*, Wlk.

Chapra (Mackenzie).

The Fauna gives Burma only.

63. *Diplorhinus quadricornis*, Stål.

Chapra (Mackenzie).
The Fauna gives Assam and Burma.

64. *Tetroda histeroides*, Fabr.

Pusa. 14-ix-08.
Salem. 14-viii-07.
The Fauna records are Sikhim, Nagas, Burma, Malay Peninsula.

65. *Megarhynchus rostratus*, Fabr.

Pusa. 10-iii-05—vi-05—3-xi-06—25-xi-04—19-xii-05.
Siripur. 18-viii-05.
Comilla. 21-i-06.
Chapra.
The Fauna records Sikhim, Assam, Burma, Malaya, etc

66. *Megarhynchus truncatus*, Westw.

Pusa. 30-iii-06—iii-07.
The Fauna records Naga Hills, Khasis, Burma, Malaya, etc.

In this sub-family all our species are known also from Burma.

UROSTYLINÆ.

None have been found; there are fifteen species known from the neighbouring Himalayas, but none appear to occur in this tropical area.

ACANTHOSOMATINÆ.

67. *Microdeuterus megacephalus*, Herr.-Schäff.

Pusa. 25-xii-08—28-viii-07.
Belgaum. iv-08.
The Fauna records Bombay, Calcutta, Sikhim, Burma

68. *Microdeuterus dallasi*, Atk.

Pusa. xi-08—26-iv-08—3-v-06—26-iv-06.
Chapra (Mackenzie).
Recorded from North India.

Anaxandra and *Elasmostethus* have been found, but the specimens have been sent for accurate determination.

In this family, the dates of capture are not of much value, since the adult is always to be found; that is, hibernation or similar

seasons of rest are passed in that stage. We have mentioned a few "cold weather species" but such are far less marked than in other orders and this, which is so marked a feature of our tropical fauna, is here inadequately brought out.

The Pentatomidæ are a family which offer valuable data for faunistic purposes, because they have been more collected than any other families. The occurrence of Cydninæ and Graphosomatinæ, the absence of Tessaratominæ and Urostylinæ, are marked features in comparing a tropical fauna such as this with the nearest sub-tropical one, and this family alone offers good reason for the fundamental distinctions between sub-tropical and tropical faunæ which I have suggested in *Indian Insect Life.*

Conclusions.

(1) The fauna of the Gangetic Plain, West, as a tropical area, consists of a few species, well established and abundant, and some less abundant.

The well-established very abundant ones may be those tbat have accustomed themselves to dry heat and having less inter-species competition, and a greater amount of food, become abundant. That is, if a species can live at all, it is likely to do very well if its food is one of the common plants or insects, because there are few plants but many of each. That is a characteristic of the tropical zone, whereas in moist sub-tropical areas there is a greater diversity of food plants but less of each; there are in the latter more species, more inter-species competition, a greater diversity of fauna but few really abundant dominant species. One can see that, if one collects in both areas, very markedly.

(2) There is a greater fauna of species living in soil than there is in a sub-tropical region. Plataspidinæ, Graphosomatinæ, Cydninæ are actually largely soil-living, root-feeding forms very largely. They are enormously abundant in this tropical fauna, very scarce in a sub-tropical one.

(3) A large percentage of the fauna is common also to Assam, Burma, Malay Archipelago.

(4) The fauna owes little to the neighbouring sub-tropical ones of the Himalayas.

(5) It contains a small definite number of cold weather species, derived probably from North-West India (the Indus Plain).

(6) There is no real indigenous fauna; all is derived from areas of older geological formation.

(7) There is a proportion of well-established species found all over the tropical plains; there is also a proportion probably peculiar to this and the Gangetic Plain, East,

not found for instance in the Deccan, West Coast, or Coromandel Coast.

(8) A number of species established in the Gangetic Plain, East, are not so established or found in this area, and the division of Gangetic Plain, East and West, dividing somewhere about Purneah, is valid.

COREIDÆ.

COREINÆ.

69. *Elasmonia granulipes*, Westw.

Pusa. vi-08.
Lebong. ix-08—v-09.
A Sikhim species, rare in Pusa.

70. *Anoplocnemis phasiana*, Fabr.

Pusa. 21-ix-06—22-vi-05.
Siripur. 18-viii-05.
Nilgiris. 7,000 feet. v-04.
Igatpuri. 20-vi-04.

The Fauna records a widespread sub-tropical distribution but includes Sibsagar, Bombay and Bangalore. The species is Malayan and Himalayan.

71. *Homœocerus inornatus*, Stål.

Pusa. 10-vi-05—vi-07—vi-06—14-viii-07.
Jullundur. 25-vii-05.
Chapra (Mackenzie).

This species is confined to the sissu tree and breeds on it from June to August. Where it spends the intervening months is not known.

The Fauna gives Sikhim, Pondicherry, Burma, China.

72. *Homœocerus prominulus*, Dall.

Chapra (Mackenzie).
Surat. 16-xi-03—18-xii-03.
The Fauna records North Bengal, Bombay, Ceylon.

73. *Aschistus brevicornis*, Dall.

Pusa. ix-06—22-v-05.
Chapra (Mackenzie).
Bilaspur. iii-07.
The Fauna records North Bengal.

74. *Notobitus meleagris*, Fabr.

Chapra (Mackenzie).
Purulia. xi-06.

Ranchi. xi-06.
Simla. x-07.
The Fauna records Bombay, Khasi Hills, Burma.

75. *Plinachtus acicularis*, Fabr.

Muzaffarpur. 16-xi-04.
Matheran. iv-08.
The Fauna gives Bhutan, Bombay, Ceylon.

76. *Cletus bipunctatus*, Westw.

Pusa.—All months.
Surat.—April to August.
Tribeni. 22-iii-05.
Chapra. x-04.
Katni. ii-07.
Palamau. ix-06.
The Fauna gives Bombay, Calcutta, Bangalore, Ceylon, Burma. This is the tropical form, while *C. punctulatus*, Westw., is the sub-tropical one.

77. *Cletus punctiger*, Dall.

Pusa. 14-vi-06—7-vii-06.
The Fauna gives Murree, Calcutta, Pegu, China.

78. *Cletomorpha hastata*, Fabr.

Pusa. 9-viii-05.
Chapra.
Parel. 7-iii-05.
Matheran. iv-08.
The Fauna gives Karachi, Bombay, Calcutta; except for Matheran, a tropical species.

In this sub-family there is a marked absence of the large forms so common in sub-tropical India. If they occurred they would be found, and in quite short periods of collecting in sub-tropical areas we have obtained abundant species not found in Pusa. The difference is very marked and is, we believe, due largely to the scanty tree flora of the plains.

PSEUDOPHLŒINÆ.

79. *Clavigralla gibbosa*, Spin.

Pusa.—Most abundant from January to May when it breeds.
Surat.—December to April, abundant.
Bilaspur. ii-07.
Purulia. xi-06.
Katni. ii-07.

Lebong. ix-08.
Buxar Duars.
The Fauna records Bombay, Bangalore, Tenasserim; a tropical species.

80. *Stenocephalus laterarius*, Sign.

Pusa. 27-v-06.
The Fauna gives Bombay and Madras, Ceylon.

ALYDINÆ.

81. *Leptocorisa varicornis*, Fabr.

Pusa.—Breeds May to November.
See *Memoirs Agricultural Department*, Entom. II, No. 1, for full localities. They include all rice areas, both tropical and sub-tropical localities. Ceylon, Burma, Malaya, China are added by the Fauna.

I cannot recognise *L. acuta*, Thunb., or *L. costalis*, Herr.-Sch., but the latter I believe I recognise in some of Mr. Mackenzie's Chapra specimens. I do not include it as a distinct species.

82. *Riptortus pedestris*, Fabr.

Pusa. 24-viii-06—25-ix-07—xii-08—24-x-05.
Lebong. ix-08.
Manickganj. 28-x-06.
The Fauna gives Bombay, Bangalore, Ceylon, Khasis, Burma, etc.; except for Lebong it might be a clear tropical species.

83. *Riptortus fuscus*, Fabr.

Pusa. 20-iii-05—25-ix-05—20-iii-05.
Cuttack. x-05.
Lebong. vi-09.
Manickganj. 25-x-06.
The Fauna gives Bengal, Bombay, Bangalore, Ceylon, Burma, Malaya.

84. *Riptortus linearis*, Fabr.

Pusa.—All months.
Balaghat. iii-07.
Cuttack. xi-05.
Comilla. 22-i-05.
Munshiganj. 21-i-06.
Manickganj. 29-x-06.
The Fauna records such sub-tropical spots as Sikhim, Bor Ghat, etc.; also Bangalore, Ceylon, Burma, Malaya, etc.

The species is *the* common one in Pusa, breeding freely when it can feed on leguminous pods.

85. *Akbaratus fischeri*, Dist.

Pusa. 24-vii-08.
Surat. 16-viii-04.
Chapra.
An insufficiently known species.

CORIZINÆ.

86. *Corizus rubicundus*, Sign.

Pusa. 20-xii-07—vi-07—iii-07.
Surat. vi-04—8-xii-04.
Recorded from Ceylon.

87. *Corizus bengalensis*, Dall.

Pusa. 10-vii-07—xi-07—9-iv-06—21-v-06—10-i-07—8-xii-05.
Surat. 19-ii-04.
Mussoorie. x-06.
Chiniot. 8-vii-07.
Jullundur. 12-vii-06.
Buxar Duars. v-07.
The Fauna gives North Bengal and the Bor Ghat.

I confess to doubt as to these being distinct and I lay no stress on their occurrence. In view of the remarkable colour changes of this insect at the last moult, I cannot believe they are distinct. I have however followed Distant, who presumably has clearly distinct series.

The insect is abundant at Pusa.

88. *Serinetha abdominalis*, Fabr.

Pusa. vi-07.
Kanara. viii-07.
Bankura. iii-07.
Burdwan. iii-06.
Tribeni. 23-iii-05.
The Fauna records Bombay, Calcutta, Assam, Ceylon, Tenasserim.

S. augur, Fabr., we have not found.

This family offers little but the marked paucity of large forms already commented on. Its members here are largely Burmese or Malayan, and our fauna owes little to neighbouring sub-tropical areas; rather our species may be those of the Gangetic Plain, East, able to stand the greater dryness and heat of our area and migrated in from the East.

BERYTIDÆ.

89. *Metacanthus pulchellus*, Dall.

Pusa. vi-06—iv-07.

LYGÆIDÆ.

LYGÆINÆ.

90. *Lygæus militaris*, Fabr.

Pusa.—In all months.
Igatpuri. 20-vi-04.
Bilaspur. ii-07.
Bankura. iii-05.
Surat. 27-v-04.
Lyallpur. 10-vii-06.
Purulia. xi-06.
Madras. 12-x-07.

The Fauna gives localities in tropical India, from Murree to Mysore, also Burma, Malay Archipelago.

A very common tropical species.

91. *Lygæus hospes*, Fabr.

Pusa.—In all months.
Surat. 6-v-04.
Muzaffarpur. 12-x-04.
Bankura. iii-06.
Palamau. ix-06.
Lyallpur. 10-vii-06.

The Fauna records Sind, Bombay, Madras, Bangalore, Nilgiris, Ceylon, Burma, Malay, etc.; Sind is a notable locality, as few of our species above have been recorded from further north-west than the north-western limits of this sub-province.

92. *Lygæus fimbriatus*, Dall.

Pusa, 26-viii-08.

Recorded in the Fauna from Assam and Burma. A rare species here.

93. *Graptostethus servus*, Fabr.

Pusa.—All months.
Surat. 6-v-04.
Chapra. 22-x-04.
Bilaspur. ii-07.

Another Malayan species, recorded in the Fauna from Assam, Bombay, Calcutta, Nilgiris, etc., as well as Ceylon and Burma.

94. *Graptostethus trisignatus*, Dist.

Pusa. 26-iii-05.
Jorhat.
The Fauna gives Naga and North Khasi Hills, and Burma.

95. *Graptostethus maculatus*, Dall.

Pusa. 28-ix-05—2-ii-05—13-iii-05.
The Fauna records North India and Narkanda.

96. *Aspilocoryphus guttiger*, Dall.

Pusa. 19-v-06—13-iii-06.
North Bengal is the only record.

97. *Nysius minor*, Dist.

Pusa.—Common at all times.

This is a species described since the Fauna volume. I am not prepared to recognise any other species in Pusa though Mr. Distant might and Mr. Kirkaldy presumably would find several. I believe that food plants and perhaps climate influence this species like all others, and I am extremely surprised a new species should be made of our form. My own feeling is that long series from different places and collected at different times will, in this genus, reduce the now existing six Indian species to fewer. *Nysius*, as a genus, is distinct enough; its species are not, but the genus is widespread in India, both in the plains and to such elevations as 7,000 feet as at Simla. I have omitted all records except Pusa, as I cannot satisfactorily place our other forms among the six described species.

If any sub-family should give us data, it is this, as its members are those most likely to have been collected; we have not found *Graptostethus argentatus*, Fabr., nor *G. dixoni*, Dist., though we have the latter from several places in Central India, East. Several North Indian species, such as *Cænocoris*, are not found and our fauna appears to be from Assam or Burma, as in the previous families.

CYMINÆ.

98. *Cymus tabidus*, Stål.

Pusa. 19-vii-08.

Recorded from Bengal. Mr. Distant has seen our specimens. It is an inconspicuous insect, probably not confined to Bengal.

BLISSINÆ.

99. *Macropes punctatus*, Wlk.

Muzaffarpur. 17-x-04.
Recorded from North India.

100. *Macropes excavatus*, Dist.

Pusa.—All months.

Recorded from Shillong.

We have a very long series from Pusa, which may or may not be one species. Allowing for newly transformed individuals, which are brown, for the varying shrinkage of the abdomen according to the chitin being less or more hardened with the duration of time from the last ecdysis, and for variation, it is very hard to place a long series in any one species. At all events most of ours agree with this species but others, *e.g.*, *M. dilutus*, may also occur.

101. *Blissus gibbus*, Fabr.

Pusa. 29-xii-04—18-i-05—13-vi-05.

Belgaum. iv-08.

The Fauna gives Bor Ghat and Cawnpore. A retiring root-feeding species, seldom seen but probably widespread.

GEOCORINÆ.

102. *Geocoris tricolor*, Fabr.

Pusa.—All months.

Surat. 7-iv-04—9-vii-04.

Lebong. ix-08.

Chapra. 22-x-04.

The Fauna gives Calcutta, Bangalore, Bor Ghat, Ceylon, Burma. This is equivalent to its being widespread over tropical India.

COLOBATHRISTINÆ.

103. *Artemidorus pressus*, Dist.

Pusa. 30-v-06—26-i-04.

Matheran. iv-08.

The Fauna gives Calcutta, Ceylon, Burma.

HETEROGASTRINÆ.

104. *Epibomius pusa*, Dist.

Pusa.—Date removed in transit.

A new species, apparently rare.

105. *Dinomachus rhacinus*, Dist.

Pusa. 12-vii-06—26-iv-06—21-ix-08.

An abundant species on tree trunks, described since the Fauna.

PACHYGRONTHINÆ.

None found.

OXYCARENINÆ.

106. *Oxycarenus lætus*, Kby.

The species abundant wherever cotton is, from Tinnevelly to the north-west. Its scanty record in the Fauna shows how little Lygæids have been collected.

107. *Oxycarenus lugubris*, Motsch.

Pusa. 13-vi-05.
Recorded from Ceylon only.

APHANINÆ.

108. *Paromius seychellesus*, Wlk.

Pusa. 3-viii-05.
Palamau.
Manickganj. 24-x-06.
Barisal. 8-vi-06.
Recorded from Ceylon, Burma, etc.

109. *Paromius exiguus*, Dist.

Pusa. 22-iii-06.
Recorded from Ceylon and Japan. Mr. Distant identified our specimens.

110. *Pamera pallicornis*, Dall.

Pusa. 31-viii-04—25-vi-06—6-x-06—5-vii-07—4-ix-07.
Chapra.
Lebong. ix-08.
The Fauna gives Shillong, Kurseong, Ceylon, Burma, etc.

111. *Pamera vincta*, Say.

Pusa. 27-vi-06—30-x-06—26-vi-07.
Manickganj. 26-x-06.
The Fauna gives Ranchi, Calcutta, Ceylon, Burma. It is a grass and soil species, probably widely spread in India, but not noticed.

112. *Appolonius cincticornis*, Wlk.

Pusa. 3-v-06.
Recorded from Ceylon.

113. *Lachnophorus cingalensis*, Dohrn.

Chapra (Mackenzie).
Nagpur. 21-i-06.
Recorded from Bor Ghat, Bombay and Ceylon.

114. *Adauctus cupreus*, Dist.

Pusa.—Date lost in transit.
A new species.

115. *Aphanus sordidus*, Fab.

Pusa. 14-xi-04—4-iii-05—17-vii-07.
Belgaum. iv-08.
Ranchi. xi-06.
The Fauna records Assam, Bengal, Bombay, Ceylon, Burma, etc.

116. *Aphanus bengalensis*, Dist.

Pusa. 1-vii-07.
Chapra.
A new species.

117. *Dieuches uniguttatus*, Thunb.

Pusa.—All months.
Dacca. 10-i-08.
Belgaum. iv-08.
Recorded by the Fauna from Assam, Bangalore, Ceylon, Andamans, Burma, etc.
A very common species here.

118. *Dieuches leucoceras*, Wlk.

Chapra (Mackenzie).
Mussoorie. viii-07.
Buxar Duars. iv-08.
Kangra (Dudgeon).
Lebong. ix-08.
Recorded from Kashmir, Bor Ghat, Bombay, Ceylon and Bushire (Persia).

119. *Pœantius festivus*, Dist.

Pusa. 2-iii-05—29-xii-07—26-vi-07.
Recorded in the Fauna from Ceylon and Calcutta.

120. *Abanus coloratus*, Dist.

Chapra (Mackenzie).
A new species.

121. *Lethæus indicus*, Dall.

Pusa. vi-07—9-xii-05.
The Fauna gives North Bengal and Burma.

122. *Gonsalvus typus*, Dist.

Pusa. 8-iv-07.
Recorded by the Fauna from Mandalay.

With regard to the Lygæidæ as a whole not much can be said. There is a predominance of forms found also in Assam, Burma and Malaya, few of which extend either to the nearest sub-tropical area or to the tropical regions in the north-west. The palæarctic forms which have migrated from Sind into North India have not reached the Western Gangetic Plain. Unfortunately the Lygæidæ are little collected; they are small, not easy to identify, uninteresting as "specimens," and very little known. Many more of the obscurer forms of Pusa remain to be found and described probably, and a number are with Mr. Distant or are awaiting description. Such forms, however, being new, offer no data with regard to faunal zones.

PYRRHOCORIDÆ.

LARGINÆ.

123. *Iphita limbata*, Stål.

Pusa. 28-iii-05—23-iv-07—25-vii-05—6-ix-07—16-xi-04—25-xii-05.

Dacca. 15-i-06.

The Fauna records Assam, Hardwar, Calcutta, Tenasserim.

124. *Physopelta gutta*, Burm.

Pusa. 9-xii-05.
Lebong. ix-08.
Helem.
The Fauna records Assam, Ceylon, Burma, etc.

125. *Physopelta schlanbuschi*, Fabr.

Pusa. 23-xii-05—20-viii-07—3-ii-06.
The Fauna records Assam, Burma, etc.

In this sub-family, the only notable thing is the complete absence in Tirhut of *Lohita grandis* which has, apparently, not got beyond the limits of the Gangetic Plain, East. Our three Larginæ are all common to Assam and Burma.

PYRRHOCORINÆ.

126. *Antilochus coqueberti*, Fabr.

Pusa.—All months.
Helem.
Bor Ghat. 13-iii-03.
Baroma. 2-iii-07.
Jammoo. 11-iv-08.
Buxar Duars.
Cuttack. xi-05.

The Fauna records Kashmir, Assam, Calcutta, Secunderabad, Ceylon, Burma, etc.

127. *Euscopus indecorus*, Wlk.

Pusa. 6-xii-05.
Recorded from Assam, Ceylon, Burma, Siam.

128. *Dermatinus lugubris*, Dist.

Pusa. 17-vii-05.
Nilgiris. 10-iv-06.
Igatpuri. 20-vi-04.
Bilaspur. ii-07.
Recorded only from Pondicherry.

129. *Scantius pallens*, Dist.

Pusa. 6-vii-07—2-vi-08.
Katni. ii-07.
Nagpur. 5-iii-05.
Hafizabad. 21-vii-06.
Recorded from Sind.

130. *Scantius volucris*, Gerst.

Pusa. 11-vii-05.
Bulsar. 21-v-04.
Bilaspur. ii-07.
Lahore. 19-iv-08—7-ix-04.
Recorded from Madras, Coonoor, British East Africa.

131. *Dysdercus cingulatus*, Fabr.

Throughout the cotton-growing areas of India, and practically throughout the tropical area. In sub-tropical localities such as Sikhim up to 5,000 feet.

Recorded from Burma, Ceylon, Malaya, etc.

132. *Dysdercus evanescens*, Dist.

Pusa. 4-iv-07—10-viii-08.
Chapra.
Bor Ghat. 14-iii-01.
Buxar Duars. v-07.
Recorded from Sikhim, Assam, Bor Ghat and Burma.

Our fauna is a small one, not containing many species, *e.g.*, *Dindymus*, *Odontopus*, etc., of Assam, and without immigrants from the North-west such as *Pyrrhocoris* that one might expect.

TINGIDIDÆ.

133. *Cantacader uniformis*, Dist.

Pusa. 6-iii-05.
Recorded from North Bengal and Burma.

134. *Serenthia gibba*, Fieb.

Pusa. 25-ix-06.
Recorded from "East India."

135. *Paracopium cingalense*, Wlk.

Bhagalpur. iii-09. (E. J. Woodhouse.)
The Fauna records Ceylon. Bhagalpur is in our area, doubtfully.

136. *Galeatus darthula*, Kirk.

Pusa. x-08.
Recorded from Ceylon.

137. *Celantia vagans*, Dist.

Pusa. 15-iv-08.
Recorded from Ceylon.

138. *Compseuta lefroyi*, Dist.

Pusa.—Date lost in transit.
A new species.

139. *Monanthia globulifera*, Walk.

Pusa.—All months.
Recorded from Ceylon and Madras.

140. *Belenus bengalensis*, Dist.

Pusa. 10-viii-08—20-xi-08.
Muzaffarpur. 10-x-04.

Records of Tingididæ are so scanty, there is nothing to say of our species. Many remain to be found here, and collecting is badly needed everywhere in the plains. The family is quite as much tropical as sub-tropical.

PHYMATIDÆ.

Of the nine Indian species, we have none from the plains at all. The family appears to be essentially sub-tropical, though nowhere abundant.

ARADIDÆ.

No species known from our Fauna. They are not uncommon in sub-tropical India.

HEBRIDÆ.

None known.

HYDROMETRIDÆ.

MESOVELIINÆ.

141. *Mesovelia mulsanti*, Buch. Wh.

Pusa. 2-i-07.
Recorded from Ceylon, Sumatra, etc.

HYDROMETRINÆ.

142. *Hydrometra vittata*, Stål.

Pusa.—All months.
Muzaffarpur. 13-i-05.
Jalalpur. 24-v-04.
Recorded in the Fauna from Bombay, Bor Ghat, Ceylon, Burma, Malaya, etc.

VELIINÆ.

143. *Microvelia repentina*, Dist.

Pusa. 16-i-07.
Recorded from Calcutta.

144. *Microvelia singalensis*, Kirk.

Pusa. 16-i-07, etc.
Recorded from Ceylon. It is common on stagnant water with the last species.

GERRINÆ.

145. *Gerris nitida*, Mayr.

Pusa. 21-xii-04—9-i-05.
Recorded from Trivandrum, Ceylon and Burma.

146. *Gerris tristan*, Kirk.

Pusa. 24-xii-04.
Recorded from Ceylon.

147. *Gerris spinolæ*, Leth. et Sev.

Pusa. 24-xii-04.
The Fauna records North India, Calcutta, Ceylon, Burma, China.

HENICOCEPHALIDÆ.

148. *Henicocephalus basalis*, Westw.

Pusa.
Chapra.
Cuttack.

The Fauna gives Bengal, Bombay, Bor Ghat, Coromandel, Burma.

A widespread, retiring, tropical insect.

REDUVIIDÆ.

HOLOPTILINÆ.

We have none of the four likely species.

EMESINÆ.

We have three species, apparently new to the Fauna.

SAICINÆ.

Polytoxus occurs, apparently new species.

TRIBELOCEPHALINÆ.

None known.

STENOPODINÆ.

149. *Pygolampis fœda*, Stål.

Pusa. vii-07.

The Fauna records Ceylon, Burma.

150. *Staccia diluta*, Stål.

Pusa. 13-vi-06.

Recorded from Ceylon and Burma.

151. *Oncocephalus annulipes*, Stål.

Pusa. 4-vi-04—24-ix-05—28-vi-05.

Surat. 12-vi-04—7-vii-04.

The Fauna gives Kashmir, Bombay, Bor Ghat, Ceylon, Burma, etc.

152. *Caunus farinator*, Reut.

Pusa. 25-vii-08.

Recorded from Tranquebar.

In this sub-family, our fauna is small, with its origin to the South-east rather than the North-west. It is not complete enough to be satisfactory, and many species may remain to be found.

SALYAVATINÆ.

None found. Only three are recorded in India, two in Sylhet, one in Pondicherry.

ACANTHASPIDINÆ.

153. *Reduvius cincticrus*, Reut.

Pusa. 22-ix-06—26-vi-09.
Recorded from Sylhet.

154. *Acanthaspis coranodes*, Stål.

Pusa. 6-vii-06—17-ii-05.
Daltonganj. viii-05.
Recorded from Sylhet.

155. *Acanthaspis rama*, Dist.

Pusa. 5-iv-05—12-v-06—8-v-07—14-iii-09—viii-08.
Chapra.
Lebong. ix-08.
Recorded in the Fauna from Sikhim and Berhampur.

156. *Acanthaspis rugulosa*, Stål.

Pusa. 17-vii-05.
Chitrakot. iii-08.
Chapra.

In this sub-family, there are many species found in Burma that do not occur in our area. What we have is common to the Gangetic Plain, East, and Burma usually, while we have little in common with the Himalayas. We have few *Acanthaspis* but the abundant species. *Conorhinus* would probably be found, had not Pusa been uninhabited for many years prior to 1904, as it is essentially a household species.

PIRATINÆ.

157. *Phalantus geniculatus*, Stål.

Pusa. 1-vii-06.
Recorded from Burma and China.

158. *Ectomocoris cordiger*, Stål.

Pusa. iii-09—iii-06—16-v-06—10-vii-06.
Bankipur. vii-08.
Burdwan. iii-06.
Chapra.
Recorded from N. Bengal, Bor Ghat, Sylhet, Ceylon, Persian Gulf.

159. *Pirates sanctus*, Fabr.

Chapra (Mackenzie).
Baroma. 6-iii-07.
Recorded from Sind, N. Bengal, Burma, Ceylon.

160. *Pirates quadrinotatus*, Fabr.

Pusa. 27-i-05—7-vii-05—26-vi-07.
Chapra.
Recorded from Sylhet and Ceylon.

161. *Pirates lepturoides*, Wolff.

Pusa. 10-ii-09—10-x-08.
Chapra.
The Fauna records Khandala, Ceylon, Burma, Java, Barnes.

162. *Pirates mundulus*, Stål.

Pusa. 4-vi-07.
Surat. 21-ii-04.
Cuttack. 23-xi-05.
Dacca. 16-i-06.
Chapra (Mackenzie).
The Fauna records Tranquebar, Bor Ghat, Ceylon.

163. *Pirates atromaculatus*, Stål.

Pusa. iii-09—8-ix-08—18-vii-08—x-08—7-iv-07.
Chapra (Mackenzie).
The Fauna gives Assam, Burma, Ceylon, etc.

164. *Sirthenea flavipes*, Stål.

Chapra (Mackenzie).
Khasi Hills. v-05.
The Fauna records Naga Hills, Ceylon, etc.

In this sub-family our fauna is essentially Burmese, and not usually recorded from further North-west.

ECTRICHODIINÆ.

165. *Ectrychotes abbreviatus*, Reut.

Pusa. 6-ix-07—26-iii-05—27-i-05.
The Fauna records Calcutta only.

166. *Ectrychotes dispar*, Reut.

Pusa. 21-ii-05—17-xii-04—27-iv-06—14-iv-08.
The Fauna records Calcutta, Bombay, Bangalore.

167. *Physorhynchus tuberculatus*, Stål.

Pusa. 1-iii-07—3-iv-08.
The Fauna records Assam, Burma, Ceylon. It is with us a rare species, the largest of the Pusa fauna.

APIOMERINÆ.

None recorded.

HARPACTORINÆ.

168. *Harpactor marginatus*, Fabr.

Chapra (Mackenzie).
Katni. ii-07.
The Fauna records North India, Vizagapatam, Ceylon.

169. *Harpactor costalis*, Stål.

Pusa. 7-i-09—iii-09—25-vi-08—8-vii-07.
Lebong. ix-08.
The Fauna records Bengal, Assam, Burma, Malay Peninsula.

170. *Sphedanolestes mendicus*, Stål.

Pusa. 2-viii-07—1-vi-07.
Chapra (Mackenzie).
Mussoorie. viii-07.
The Fauna records Assam, Burma, Malay Peninsula.

171. *Sycanus versicolor*, Dohrn.

Pusa. 12-xi-06.
Recorded from Bengal, Burma, Penang.

172. *Cydnocoris crocatus*, Stål.

Chapra (Mackenzie).
Recorded from Burma.

173. *Coranus spiniscutis*, Reut.

Pusa.—All months.
Purulia. xi-06.
Cawnpur. 15-x-05.
The Fauna records Assam, Ranchi, Bor Ghat and Burma.

This is, in Pusa, very common all the year, predaceous on caterpillars and small insects.

174. *Coranus obscurus*, Kby.

Pusa. iii-09—15-i-05—28-viii-08.
Rasulpur, Bengal. iv-06.
Recorded from Sikhim, Assam, Calcutta, Ceylon and Burma.

I am not certain that *C. fuscipennis*, Reut., is not in our series as I do not regard the descriptions as very distinctive.

175. *Scipinia horrida*, Stål.

Pusa. 11-x-06.
Chapra. 22-x-04.
Recorded from Sikhim, Ceylon, Burma, Philippines.

176. *Irantha consobrina*, Dist.

Pusa. 12-iii-07.
Recorded from the Nilgiris only.

In the Harpactorinæ, our fauna has distinct affinities to that of Assam and Burma, but is very limited; it suggests that only a small number of forms really have passed on from Assam and Eastern Bengal (Gangetic Plain, East) to our area, that we are the extreme north-west limit of some forms and too far out of the moist warm areas for many more.

NABIDINÆ.

177. *Prostemma carduelis*, Dohrn.

Pusa. 17-xii-04.
Recorded from Ceylon and Burma.

178. *Prostemma flavomaculatum*, Leth.

Pusa. 21-xii-04.
Recorded from Burma.

179. *Nabis capsiformis*, Germ.

Pusa. 21-i-09—iii-07—15-vii-06—6-iv-07.
Surat. 15-viii-04.
Simla. x-07.
Recorded from Bombay and Bor Ghat, and Burma. Also the Palæarctic, Nearctic and Ethiopian regions. A very abundant species, which feeds on caterpillars.

The Reduviid Fauna of Pusa and Chapra is small, with many species not recorded which do occur in Eastern Bengal and Assam, and with very few species known also from the Himalayan subtropical areas to the north. Until the Reduviid Fauna of the Punjab is known, it is not possible to contrast our fauna, but its affinities, so far as can be seen, are with Eastern Bengal, Assam, Burma and Malaya, far more than with that of Sub-Himalaya or the North-west.

SALDIDÆ.

180. *Valleriola cicindeloides*, Dist.

Pusa. iv-08.
Nagpur. ii-09.
A new species, rare.

CIMICIDÆ.

181. *Cimex rotundatus*, Sign.

This is stated to be the Indian species, found at Pusa as generally in India.

CAPSIDÆ.

MIRINÆ.

182. *Callicratides rama*, Kby.

Chapra (Mackenzie).
Recorded only from Ceylon.

183. *Megalocerœa dohertyi*, Dist.

Pusa.—All months.
Recorded from Tenasserim.
I am not quite certain of this species; it is nearest to *M. dohertyi* of those in the Fauna.

184. *Megacœlum stramineum*, Walk.

Pusa.—All months.
Surat.—All months.
Recorded from North Bengal, Kangra Valley, Ceylon. A very abundant insect.

CAPSINÆ.

185. *Pœciloscytus longicornis*, Reut.

Pusa. 20-iv-07.
The Fauna records Calcutta, Ceylon, Nicobar Islands, etc.

186. *Gallobelicus crassicornis*, Dist.

Pusa.—All months.
The Fauna records Bor Ghat and Tenasserim.

187. *Halticus minutus*, Reut.

Pusa. 7-vii-05.
Recorded from Ceylon, Singapur, etc.

The Capsid fauna is very inadequately known, compared with other families, but is a distinct one from that of sub-tropical localities; for instance the very abundant *Deræocoris* of the Himalayas, which are there quite common, are in Pusa wholly absent. Our Capsid fauna is probably distinct, being fonud on grass and on plants to which each species is more or less definitely confined. The Capsidæ, more than all other Heteroptera, are very insufficiently known all over India.

ANTHOCORIDÆ.

188. *Triphleps tantilus*, Motsch.

Pusa. viii-07.
We have also a not uncommon undescribed species.

PELOGONIDÆ.

189. *Pelogonus marginatus*, Latr.

Pusa.—All months.
The Fauna records India, Burma, S. Africa, etc.

NEPIDÆ.

190. *Laccotrephes ruber*, Linn.

Pusa. 19-viii-05—15-vi-06—24-iv-07.
Chapra.
Igatpuri. 20-vi-04.
Nilgiris. 7,000 feet. v-04.
Akalgarh, Punjab. 30-iii-08.
Recorded from Sind, Kashmir, Assam, Kangra, Bombay, Calcutta, Ceylon, Burma, China, etc.

191. *Laccotrephes maculatus*, Fabr.

Pusa.—All months.
Recorded in the Fauna from Bengal, Assam, Calcutta, Bombay, Ceylon, Burma.

192. *Ranatra elongata*, Fabr.

Pusa. 26-iii-04—viii-08.
The Fauna records Kashmir, Calcutta, Bombay, Nilgiris.

193. *Ranatra filiformis*, Fabr.

Pusa.—All months.
The Fauna records Quetta, Karachi, Behar, Assam, Tranquebar, Bombay, Philippines, etc.

NAUCORIDÆ.

None.

BELOSTOMIDÆ.

194. *Nectocoris stali*, Mayr.

I cannot find we have this, but am not certain.

195. *Sphærodema annulatum*, Fabr.

Pusa. 19-xii-04—19-viii-05—14-v-07.
Burdwan. ii-06.
The Fauna gives only Sind, Sylhet, Calcutta.

196. *Sphærodema rusticum*, Fabr.

Pusa. 25-ix-05—iv-05.
Dacca. xii-08.
Yercaud.
Gauhati. v-07.
The Fauna gives Bombay, Ceylon, Burma, Siam, etc.

197. *Sphærodema molestum*. Duf.

Pusa. 1-vii-07—v-07, etc.
Bangalore.
The Fauna records Kashmir, Calcutta, Malacca.

198. *Belostoma indicum*, Lep. et Serv.

Pusa.—May to September.
Asansol.
Mokameh.

Recorded from Sind, Malabar, Bombay, Trivandrum, Ceylon, Burma, etc.

The Corean *B. deyrollei*, Vuill, of the Brahmaputra, the only other Indian species, does not appear to extend to our area.

NOTONECTIDÆ.

199. *Enithares indica*, Fabr.

Pusa. 17-xii-06.
Surat. 16-vi-04.

Recorded from Tranquebar, Bombay, Trivandrum, Ceylon, Burma, etc.

200. *Anisops sardea*, Herr.-Schäf.

Pusa.—All months.
The Fauna gives Bombay, Burma, etc.

201. *Anisops fieberi*, Kirk.

Pusa.—All months.

Kirkaldy says "Distributed over British India," on whose authority is not stated. Distant records Ceylon and Celebes.

202. *Anisops niveus*, Fabr.

Pusa.—All months.

The Fauna records Bombay, Burma, and "suggests" all India.

203. *Plea pallescens*, Dist.

Pusa. x-08—ix-08—vii-09.

Recorded from Calcutta.

CORIXIDÆ.

204. *Corixa hieroglyphica*, Duf.

Pusa.—All months.

Recorded from Assam, N. Bengal, Bombay.

205. *Micronecta striata*, Fabr.

Pusa.—All months.

The Fauna records Calcutta, Kanara, Ceylon.

The aquatic Rhynchota have probably been little collected in India, and one would expect them to be widely spread, since neither heat nor drought would affect them in big rivers such as come down from sub-tropical areas. Still there are puzzles, notably *Belostoma deyrollei* from the Brahmaputra not being found in the Ganges. A feature, too, is the complete absence of *Mononyx*, so common in the hills, and of Naucoridæ. The former is a land insect typical of sub-tropical areas and the Naucoridæ apparently also are not plains' insects at all.

We have now enumerated 205 species of Rhynchota Heteroptera from Tirhut, mainly from one locality, Pusa, in which collecting has been done continuously by many students and others, as well as myself, for five years. We have probably found at least every common species; there may be another 100 rare species not listed, which are not identified or are new. The fauna as a whole is markedly Malayan and Burmese, very markedly distinct from that of the nearest sub-tropical zone, Sub-Himalaya, West. It contains also very few species stretching across the drier north-west, but probably many species common also to the hills of Chota Nagpur and other places to the south-west. How it will compare with the fauna of Central India, East, is uncertain, but we believe

that it shows a greater affinity with the Fauna of the Gangetic Plain, East, though distinct from it. The fauna is not a distinct one, in the sense that it is derived, not originating on the spot; it is derived probably by immigration through Lower Bengal and Eastern Bengal from Burma, and possibly Malaya. Many species which have penetrated into Lower Bengal have not penetrated to this area, possibly on account of the period of intense dry heat which prevails from March 15th to May 15th as a rule. It contains probably a number of species which are now established all over the plains of India, successful species whom heat does not affect or who find in the undiversified vegetation an abundance of the food-plant they require.

If our conclusions are correct, there is justification for considering what are the faunal zones of this continent. We cannot here repeat what is said in *Indian Insect Life*, but we would urge the collection of data upon this point; collectors situated in India can alone provide the data; we want collections made at widespread points by resident collectors; a collection is not a mere agglomeration of specimens, like postage-stamps, but a valuable mass of data from which can be drawn deductions regarding wide subjects such as this; there is scope for many collectors, and until such work is started, this cannot make the progress it should do.

It is perhaps unnecessary to say that we will give any assistance that can be given, and that this subject is being worked at both in the Indian Museum and Pusa. An impetus might possibly be given to collecting, were it realised how valuable are accurately localised collections. We would also point out to systematists and others in Europe that India is not just one level uniform plain and that the accurate record of localities and elevations in the specimens they describe increases the value of their work. Such a locality as "Indes Orientales" is meaningless; North Bengal may be Pusa at 150 feet elevation, Kurseong at 4,700 feet, or Darjiling at 7,000 feet, the three places being tropical, sub-tropical and palæarctic, respectively. If anyone is in doubt as to the elevation, latitude or longitude, or the faunal area of any Indian locality, we will do our best to enlighten him. The accurate record of localities is an extremely important matter, and we hope that such vague terms as "Indes Orientales," "India Orientalis," "Deccan," "Bengal," "South India," will pass completely out of use and give place to greater accuracy.

XXVI. DESCRIPTIONS OF NEW SPECIES OF *BOTIA* AND *NEMACHILUS*.

By B. L. CHAUDHURI, *B.A.*, *B.Sc.* (*Edin.*), *Assistant Superintendent, Indian Museum.*

Botia birdi, sp. nov.

Br. iii, D I.10, P 14, V 8, A I.6, C 19.

Height of body 4, length of head 4 and length of caudal 9 in the total length. The distance of cloacal opening from root of caudal is contained three times in the total length.

Head rather compressed and deep, height of head being $1\frac{2}{5}$ and its breadth $2\frac{2}{5}$ in the length of head. The suborbital groove is shaped like a relaxed bow and is deep and wide for the lodgment of the erectile bifid spine when not in use. The length of the groove is contained three times in the length of head. The erectile spine reaches the anterior third below the orbit.

Eyes lateral, with a rounded ridge between and situated about the middle of the length of the head; rather small and contained 8 diameters in the length of head, 4 to $4\frac{1}{2}$ diameters from the end of snout and $2\frac{1}{2}$ diameters apart.

Barbels.—8 in all, 4 rostral in a bunch at the end of a fleshy prolongation of the pointed snout, the inner pair being superimposed by the outer pair The mandibular pair, which are short and thick and only half as long as the maxillary (which are the longest with slender tapering ends) grow from a fleshy outgrowth of the lower lip. The maxillary pair reach the middle of the eye below, the length of the rostral barbels is intermediate between that of the maxillary and that of the mandibular; the outer and upper rostral pair being longer than the inner and inferior rostral pair.

Anterior nares are about the middle of the snout, have double funnel-shaped tufts and two deep pits, and do not open into the mouth, but the double series of muciferous glands in the head appear to terminate in front of them.

Lips.—Suctorial, thick, rounded and doubled up at the corners when the mouth remains closed, thus giving a crescentic appearance to the lumen. The upper lip is extended into an overhanging fleshy flap and the lower lip is corrugated or divided into four rounded fleshy protuberances, giving a characteristic appearance to the mouth.

Fins.—There are appendants on the outer side of pectoral and ventral fins These appendants are small, thin, cuticular flat

outgrowths in the angles of the fins. The anterior root of the dorsal fin is slightly nearer to the snout than the middle point in the total length and is in advance of the anterior root of the ventral fin, which is slightly behind the middle point. The outer free margin of the dorsal is concave outward; the pectoral fin in length is contained $1\frac{1}{6}$ times in the interval between the anterior roots of the pectoral and ventral fins; the ventral fin is contained $1\frac{1}{5}$ to $1\frac{2}{5}$ times in the interval between the anterior roots of the ventral and anal fins, and the anal fin about $1\frac{2}{5}$ times in the interval between the anterior roots of the anal and candal fins. (In each of these the length of the fin is measured as it lies contracted alongside the body length.) In the dorsal fin the spine is intimately joined with the first ray, so much so that the total number appears to be 10. The first ray though articulated is not branched, while the rest of the rays are both articulated and branched. The spine of the anal fin is also intimately joined with the first ray; thus the total number in the fins appears to be 6 and not 7 till the spine is separated out. Like that of the dorsal the first anal ray is articulated but not branched, but the rest are both articulated and branched. The caudal fin is deeply forked—more than $\frac{2}{3}$ of its total length.

Shape.—Body broader above than below. The dorsal profile is round and sloping in front of the dorsal fin, the slope increasing gradually further forward; behind the dorsal fin it is only slightly sloping. The ventral profile is almost a straight line and the abdomen is transversely rounded.

Lateral line is complete. It is almost straight from the root of the caudal fin to below the dorsal fin, from which point it slightly follows the curvature of the upper profile; it appears to terminate in the upper corner of the gill-opening. From this point again widely separated larger spots (openings of muciferous glands) are observed in two series, one curving up the eye and the other rounding below, meeting in front of the nasal openings

Air-bladder is an elongated narrow tube lying on the upper part of the gut, and in length is only $\frac{1}{3}$ the length of the gut.

Scales very small and deciduous; all over the body except on the head.

Colour.—The snont was reddish at the time of capture but has lost its colour in spirit. The outer rostral barbels are dark brown, the rest are white. Dorsal and caudal fins are striped with broad black or dark brown bands on yellowish white ground; the dorsal with 2 to 3 cross-bands and the caudal with 3 to 4 wavy bands. The other fins, *viz.*, pectoral ventral and anal, are not at all striped but are of one uniform colour which is paler yellowish white; as is also the ventral (lower) surface of the body; the dorsal side is deeper and darker, and further variegated by irregular elliptical loops of brownish black; these loops send down broad brownish black bands on each side, but all these bands stop short of the ventral surface and sometimes interlace with each other. Just below the suborbital groove there is a half-moon-shaped area

conspicuously silvery which probably functions as a warning organ.

Size.—Three young specimens from Ambala measure 12·4 cm., 12·9 cm. and 13·3 cm. Full-sized ones weigh up to $1\frac{1}{2}$ lb. each.

These fish were caught in the month of May, 1908, by W. J. A. Bird, Esq., Superintending Engineer, Sirhind Circle (Ambala), at Rupar, where the Sirhind Canal diverges from the Sutlej. The fish are said to be very good eating, and, as an individual reaches $1\frac{1}{2}$ lb. in weight, are of considerable economic value.

This fish has some superficial resemblance to a small fish, *viz.*, *Botia geto* of Day (*Cobitis geto* of Hamilton Buchanan, *Schistura geta* of McClelland and *Geto rostrata* of Günther), which, besides being a smaller fish, differs in its most important proportions, shape and formation of head (figured by Dr. Günther in the *British Museum Cat. of Fishes*, vol. vii, p. 367). There is considerable difference in the coloration also; *Botia rostrata*, Günther, has its pectoral, ventral and anal fins conspicuously striped with brownish cross-bands; in the new species none of these fins are at all banded or striped.

Nemachilus macmahoni, sp. nov.

Br. iii, D I.8, P 10, V 8, A I.6, C 19.

Height of body $5\frac{1}{5}$, length of head $4\frac{1}{5}$, length of caudal 8, the distance of cloacal opening from the root of caudal $3\frac{1}{2}$ in the total length.

Head rather broad and thick, height of head beiug $2\frac{1}{5}$ and its breadth $1\frac{1}{2}$ in the length of head and the height of head being $1\frac{2}{5}$ in the breadth of head.

Eyes small, being $9\frac{1}{2}$ diameters in the length of head, 4 diameters in the length of snout and about $3\frac{1}{5}$ diameters apart; intraorbital space very slightly convex.

Barbels.—6 in all, with thick bases and slender tips; maxillary pair reaching below hind edge of the orbit. The maxillary barbels appear to come out of the corners of a groove that surrounds the mouth.

Fins.—The single spine of the dorsal as well as of the anal is intimately joined with the first ray that follows, which, though articulated, is not branched. There is a peculiar thickening behind the dorsal fin which in appearance resembles the elongated adipose dorsal fin of some of the *Macrones*. This fin-like structure is continuous behind with the skin fold of the caudal; its length is $3\frac{1}{8}$ in the total length, and its height is contained 10 times and its thickness 12 times in the length of the fin. The anterior root of the spinous dorsal fin is in front of the middle point of the total length and also of the anterior root of the ventral fin which is behind the middle point of the total length. The length of the pectoral is $2\frac{1}{4}$ in the distance between the bases of the pectoral and ventral fins. The length of the ventral is exactly half the distance between the bases of the ventral and anal fins, and the length of the anal fin is

contained almost twice in the interval between the bases of the anal and caudal fins. Free end of dorsal fin is a straight line and the caudal is rounded.

Shape elongated and round; thicker in front and tapering from behind the dorsal fin. Dorsal profile curves up from the posterior root of the dorsal fin, reaching the highest point midway between the anterior root of the dorsal and the nape of the neck. Head not sloping but rather flat. The ventral profile is slightly curved downwards, the lowest point being the anterior root of the ventral fin.

Lateral line complete and slightly curved from below the anterior root of the adipose fin-like structure to the upper corner of the gill-cleft, and follows the curvature of the dorsal profile closely.

Scales very small and highly deciduous, found all over the body.

Colour.—Brown all over, head and dorsal part slightly darker than ventral surface. Barbels lighter brown. Dorsal and caudal fins banded with darker bands, pectoral also slightly banded; but anal and caudal of a uniform light brown colour.

The type, which is 28 cm. in length, is in the collection of the Indian Museum (No. F $\frac{1222}{1}$) and was collected in the affluents of the Helmand by Colonel Sir A. H. McMahon, K.C.I.E., C.S.I., and the officers of the Seistan Arbitration Commission. The species differs in many important characters from Tate Regan's *N. rhadinæus* from the same locality. One of the types of the latter species is also in the collection.

XXVII. NEW ORIENTAL SEPSINÆ.

By E. BRUNETTI.

The Acalypterate sub-family Sepsinæ recently received a substantial addition to the number of its Eastern species by Herr Meijere's publication of eight new ones, in addition to *javanica*, a species he had established two years earlier.

In the Indian Museum collection, this group is very liberally represented, and I now give descriptions of a number of new species therein contained, with notes on other known species and such new localities as the material presents. After careful examination of over 500 specimens, representing nearly thirty species, I find, as stated by Herr Meijere, that it is unsafe to rely too much on certain characters as bases of classification. The usual number of dorso-central bristles is four, but the front pair are frequently reduced in size, or are absent; in one specimen there was a distinct fifth bristle. The spiny bristles on the abdominal segments are also variable in size and, occasionally, in number. Moreover, all the bristles, also the spines on the fore femora, are very easily broken off, generally leaving no trace of their presence. In addition to the two conspicuous bristles on the scutellum, there are often two other very small ones towards the sides of the anterior part, and the presence of small additional bristles is not at all rare.

The two basal cells are in some species united by the absence of the intermediate veinlet, but this character is not invariably consistent, and in one specimen I found a supplementary veinlet joining the third and fourth longitudinal veins, in a line with, and apparently an extension of, the outer cross-vein.

The extent of the greyish white dust on the sternopleuræ is also more or less variable, and in some species, with an otherwise wholly black thorax, there is a tendency to a dark brown tinge on the shoulders and along the sides.

In studying the species herein recognised, I have considered all the above characters taken together, in preference to relying on any particular one. I do not feel able to present a satisfactory analytical table of species, but an approximate grouping for the present will, at least, give the affinities of my new species.

A. *Wing with a distinct black spot near tip.*

B. Wing spot rather clearly cut, generally round or squarish.

Two allied species form a first or *cynipsea* group; these are *cynipsea*, L., and *modesta*, Meij.

Four species allied to the *punctum*, F., of Europe; these are *himalayensis*, *rufibasis* (with two varieties), *similis* and *fulvolateralis*, all new.

BB. Wing spot indistinct; sometimes opened out hindwards, and fading away—never very pronounced.

In this group are *basifera*, Wlk., Meijere's *apicalis* and *limbata*, with my new ones, *flava*, *rufipectus*, *lineatipes*, *tincta*, *dilata* and *dissimilis*.

N.B.—Belonging to Group A are *fascipes*, Wlk., *linearis*, Wlk., and *monostigma*, Thoms., but from the descriptions it is impossible to tell whether they fall in my Group B or in BB.

AA. *Wing entirely clear.*

The species falling in this division appear divisible into two main groups, which I will designate the *indica* and *bicolor* groups respectively.

1. *indica*, Wied., group.—Mainly reddish yellow species of comparatively larger size. These are *indica*, W., *rufa*, Mcq., *trivittata*, Big., *spectabilis*, Meij., *tenella*, Meij., and my new species *brevicosta*, *adjuncta* and *brevis*. *Lateralis*, Wied., belongs here, but neither Meijere nor myself have been able to recognise it.

2. *bicolor*, Wied., group.—Mainly black species of comparatively smaller size. These are *bicolor*, W. (*javanica*, Meij.), *coprophila*, *decipiens* and *beckeri* of Meijere, and my new species *humeralis*, *nepalensis*, *pubipes* and *fasciculata*.

A last species, *viduata*, Thoms., is a somewhat isolated one, large, black, and with an ant-like appearance.

N.B.—Belonging to Group AA but not to be determined more closely owing to the brevity of the descriptions are *nitens*, *complicata* and *lateralis* of Wiedemann; *revocans*, *frontalis* and *testacea* of Walker.

The genus *Nemopoda* is, so far as my experience goes, not Oriental (*vide postea*).

Walker's two species of *Piophila* (the second one with a doubt)—*contecta* and *disjuncta*—I know nothing of; van der Wulp's *ruficornis* I have identified from Meijere's description adding, moreover, a variety from Calcutta (*flavifacies*).

The genus *Saltella* now becomes Oriental as well as Palæarctic, as a species occurs in Bengal, and a second in South India, both herein described. Two other species of this sub-family appear in van der Wulp's Catalogue, *Cephalia bicolor*, Big., and *Megamerina annulifera*, Big. Of these I also know nothing, and would prefer to regard them specifically and generically as uncertain.

Of the localities mentioned in this paper, Theog (8,000 ft.), Phagu (8,700 ft.), Matiana (8,000 ft.) and Dharampur (5,000 ft.) are all in the Simla (7,000 ft.) District in the W. Himalayas.

The following localities are all in South India (in Travancore State) and were visited recently (1908) by Dr. Annandale, all being

in the plains at low altitude, except Tenmalai which is among the hills :—

Trivandrum	..	Travancore State, near coast.
Nedumangad	..	10 miles N.E. of Trivandrum.
Pallode	..	20 miles N.E. of Trivandrum.
Shasthancottah	..	12 miles N.N.E. of Quilon (Travancore).
Tenmalai	..	West side of Western Ghats (Travancore).
Maddathorai	..	West base of Western Ghats (Travancore).
Shencottah	..	Madras Frontier, east side of Western Ghats (Travancore).

Sepsis cynipsea, L.

This common species, which extends over the whole of Europe, North Africa and North America, probably extends also over the whole of the Palæarctic region.

The Indian Museum possesses it from the following places: Simla (7,000 ft.), 11-v-08 and 16-v-09 (on the latter date common on flowers of white stonecrop); Theog (8,000 ft.), Phagu (8,700 ft.) and Matiana (8,000 ft.), Kufri (8,000 ft.), 11-v-09; Dharampur (5,000 ft.), 28-iv—3-v-08, and also again at Theog and Phagu, 11—13-v-09 (all *Annandale*, and all these places in the Simla District). Naini Tal (6—7,000 ft.) [*Lloyd*]; also taken by the Indian Museum collector at Unchagaon, 7-iv-09, Bindukhera, 13-v-09; Kichha, 4-iv-09, these all in the Naini Tal District but in the plains; Kumaon (Naini Tal District, 6,000 ft.), 5-vi-09; Darjiling (6,000 ft.), 28-ix—1-x-08 [*Brunetti*]; Noalpur, Nepal, 23-ii-08; Bhachkati, Bahraich District (United Provinces, India). This latter place is near the base of the Western Himalayas. I have also examined a ♂ and ♀ taken in April on Paresnath Hill, Western Bengal, by Dr. Annandale, at a height of 4,350 feet. Paresnath Hill is separated by about 200 miles from the hills of Nepal, the nearest point in the Himalayas. It will be seen that the specimens examined by me are nearly all from localities of some altitude, except the few from the plains in the Naini Tal District. I think it probable that in the East it is practically a hill species, but occurs sparingly at the base of the hills, or on isolated elevated localities in their vicinity.

Sepsis himalayensis, mihi, sp. nov.

(**Plate xiii**, figs. 1, 2.)

♂ ♀. Darjiling. Long. 2½—4 mm.

Head.—Frons shining blue-black, bare; ocelli red, equidistant, rather widely separated, with two strong, diverging bristles situated between them. A row of four equidistant bristles along the vertex, reaching from eye to eye, and some bristles of different lengths on the back of the head, which is black. Face, cheeks and mouth border red, varying to reddish brown and to reddish yellow, with a longitudinal row of strong bristles on each side of the

mouth. Proboscis light brown, with short pale hairs. Antennæ black, third joint more or less reddish, especially at base and on under side, the whole joint sometimes with a greyish reflection.

Thorax rather dull black, smooth, sometimes with a slight dark green or aënous tinge, especially on the sides. The dorsum bears five longitudinal rows of very minute spines; the middle row is central, and the outer rows nearly on the edges of the dorsum. Placed on the posterior half of the dorsum, and forming part of the two intermediate rows of minute spines, are two pairs of strong, black, spiny bristles, slightly curving backwards. *The front pair are sometimes smaller and often absent.* The lengths of the two spines forming the front pair often are unequal in the same specimen.

A strong spiny bristle in front of the insertion of each wing, and a lateral row of three on each side of the thorax, just below the dorsum. Scutellum concolorous, with two long spines; metanotum shining black. Sternopleura itself wholly grey dusted, the grey not carried forward over the mesopleura or any other portion of the side of the thorax[1] Mesopleura shining, often with an aënous or dark green tint, but never grey dusted.

Abdomen shining violet-black, with scattered, soft short hairs. Sides of second segment often more or less reddish Second segment with one or two comparatively small but distinct bristles towards the sides, almost on the posterior border. Third, fourth, fifth and sixth segments each with a strong bristle towards each side, placed near the posterior border, those on the fourth segment being just behind the middle line, although towards the sides of the segment like the others. Occasionally an additional bristle occurs on the fourth segment, and even on the fifth also, placed between the two normal ones.

Legs.—Coxæ reddish yellow, fore pair narrowly at base, and posterior pairs up the middle, black. Femora mainly shining black, but sometimes with a slight dark green tinge, with bases and tips narrowly reddish yellow. The yellow colour is variable in extent, sometimes occupying the greater part of the fore pair, especially on the under side; also in some specimens reducing the black part on the posterior femora almost to a wide, ill-defined band, or confining it (the black) chiefly to the upper side.

The fore femora in the ♂ much enlarged below, the enlargement terminating just before the end in a pair of small bumps (inner and outer) almost contiguous, which bear a few very short black spines. Three strong spines occur near together in the centre of the femora on the under side, followed by four or five shorter strong ones placed on a small bump just before the end of the incrassated part; and these stronger spines form, with some

[1] In this paper, by "sternopleura" I refer only to that subtriangular piece itself which in most Oriental species is more or less grey dusted, but in all *such cases wholly so. In the few instances where the grey is carried forward* in a thin line as mentioned by Herr Meijere in the European *Nemopoda cylindrica*, etc., I expressly take note of this fact.

intermediate small ones, a more or less regular row along the whole of the under side. Fore femora in ♀ simple. All the femora in both sexes minutely pubescent, the middle ones bearing a small spine (sometimes two) on the under side near the middle.

Tibiæ: fore pair in ♂ generally reddish yellow, narrowed at base (where there are two short black spines), also about the middle, in front of which are two small enlargements, of which the upper one bears three or four very short bristles. Fore pair in ♀ simple. Middle tibiæ with three or four bristles on the outer and hinder sides, placed on the apical half. Hind tibiæ with two bristles in the middle, on outer and hinder sides, and one on the outside near the tip, but neither the number nor the exact position seem to be constant The hind tibiæ bear at the tip several bristles of varying length. In both sexes the colour of the four posterior tibiæ is black, with rather close, black pubescence, especially on the hind pair, but the base and tip are often pale.

Tarsi: yellowish brown, black towards the tips; with black bristly hairs below, which are strongest below the metatarsus in the ♂.

Wings nearly clear: small transverse vein placed at about three-fifths of the discal cell. The spot at the tip of the second longitudinal vein is narrow on the bent up portion of that vein, below which it is enlarged, with a tendency to turn outwards towards the tip of the wing. It is never squarish in shape nor does it ever reach the third vein. This latter is *very* faintly suffused towards, but not at, its tip. Halteres pale.

Described from a considerable number of both sexes taken by me at Darjiling, 16-ix-08—2-x-08, mostly in fields of grass, mixed plants and weeds. Also in the Indian Museum from Darjiling, 10-viii-09, and Pashoke, Sikhim (2,800 ft), 5-ix-09. It is a well-marked species, but shows considerable variation, especially in the colour of the legs and at the base of the abdomen. The minute rows of spines on the thoracic dorsum are often inconspicuous or absent, and there seems a tendency towards occasional extra spines on the legs and on the fourth segment of the abdomen.

N.B.—A careful examination of all the specimens convinces me that they represent but a single species, and that the size, presence or absence, of the anterior pair of dorso-central thoracic bristles is a variable character, as about half the total number of specimens captured show four spines (the front pair generally slightly smaller, and not infrequently of different lengths in the same specimen) and the remainder show little or no trace of them, a few specimens having them of quite small size.

Sepsis punctum, Fab.

(Plate xiii, fig. 3.)

A specimen taken by me at Shanghai, 16-iv-06, agrees with the descriptions of *punctum*, F., as given by Schiner, but from comparison with four males of this species in the Indian Museum,

my specimen is much too slender and too small to be this species. It however possesses the four bristles on the fourth abdominal segment, and has only two dorso-central bristles on the thorax, in these characters agreeing with *punctum*. For the present, it will be wisest to omit the name from my list. In my collection.

Sepsis similis, mihi, sp. nov.

♂. Darjiling. Long. 3 mm.

Closely allied to *S. punctum*, F., a European species which is known to extend to North Africa. My species differs from that of Fabricius by having four dorso-central thoracic bristles, and by the absence of the middle pair of bristles on the fourth abdominal segment. Minor differences are the slightly darker hind legs, the wing spot reduced to a small dash, and the inner cross-vein being more nearly over the middle of the discal cell.

In the formation of the fore femora it agrees with *punctum*, and if the number of bristles on the thorax and fourth abdominal segment are inconstant, the two species may be identical.

Described from two males taken by me at Darjiling, 24—26-ix-08, in grassy fields. In the Indian Museum collection.

Sepsis *rufibasis*, mihi, sp. nov.

♂. Darjiling. Long. 3—4¼ mm.

A handsome and conspicuous species, allied to *punctum*, *similis* and *himalayensis*.

The second abdominal segment is always more or less reddish (above as well as at sides), the colour extending sometimes to the base of the third segment, above also; the rest of the abdomen showing violet, bronze and green tints, the fifth segment also, with the anal appendage, being principally reddish yellow. Four dorso-central bristles are present. The shape of the wing spot is as in *himalayensis*. The fourth abdominal segment carries four bristles. sometimes of unequal length (one specimen possessing a fifth bristle).

A principal specific character is the presence of bristles on the legs, distributed as follows: Several on the apical half of the under side of the middle femora, also along the whole length of the middle tibiæ on the hinder and outer sides. On the front of the hind femora towards the tips are a few, and two are in the middle of the hind tibiæ, placed somewhat posteriorly.

From *himalayensis* it may be distinguished at once by its wholly reddish yellow femora, all the legs being of that colour except the tarsi and the hind tibiæ, which are blackish. Apart from any differences contained in the above remarks this species resembles *punctum*, F.

Described from four ♂♂ in the Indian Museum collection taken by me at Darjiling, 23—26-ix-08, in fields.

Var. **major**, mihi.

♂. Darjiling. Long. 4½ mm.

Two males taken by me in company with the typical form appear at first sight to be a distinct species, although on examination it is difficult to point out any character of sufficient strength on which to separate them specifically. They are nearly 4½ millimetres in length, the whole of the second segment (abdominal) and the basal half of the third, are shining reddish ; the fifth segment being wholly yellowish, with the genitalia. There are four dorso-central bristles on the thorax, and four bristles on the fourth abdominal segment.

The bristles on the legs in one of the specimens correspond with those in the typical form, but in the other specimen they are placed more in a uniform row on the outside of the hind tibiæ (except one towards the tip in front, and one on the inside).

The wing spot is slightly larger and very deep black.

Var. **obscuripes**, mihi.

♂. Darjiling. Long. 3 mm.

What appears to be a second variety of my *rufibasis* is represented by two ♂ ♂ taken by me in company with it at Darjiling, 24—26-ix-08, in fields. In one, the four dorso-central thoracic bristles are present, in the second specimen the front pair are very abortive. One example has the tip of the abdomen (fifth segment) yellow, but the other has no sign of this colour at the tip. The leg bristles are as in the typical form, the legs themselves being much more blackish, the fore femora being nearly wholly brown in one specimen, and with a blackish upper side in the other. The posterior femora are mainly black, with the bases broadly and their tips more or less narrowly pale, and the posterior tibiæ almost wholly black, but with a tendency to paleness at the tip of the middle pair. The tarsi are dirty yellow, with blackish tips.

Sepsis fulvolateralis, mihi, sp. nov.

♂. Himalayas. Long. 3 mm.

Head.—Frons, face and cheeks bright reddish orange, frons touched here and there with black. Vertex blackish ; back of head mainly reddish yellow, but black just behind vertex. Antennæ reddish orange, upper side blackish, also the grooves in the face in which they lie ; bristle on second joint very large. Mouth blackish, proboscis brownish yellow.

Thorax.—Dorsum blackish ; four large dorso-central bristles, and five more or less uninterrupted rows of very distinct short stout bristles, the rows often double ; in addition to scattered short bristly hairs over the whole dorsum. The dorsum is sharply

divided from the sides of the thorax, which, at least on the humeral calli and for some little distance around, are distinctly reddish orange. Sternopleura prominently grey dusted, and traces of grey dust here and there above the sternopleura. Scutellum blackish. Metanotum shining black.

Abdomen shining black, with a slight violet tinge, with short pubescence. Sides at base, especially on second segment, considerably orange-yellow. Second segment with a few stiff bristles towards each side; third and fifth with two spiny bristles placed as usual; fourth with a row of four such bristles. Abdomen tip orange-yellow. Genitalia large and prominent, yellow, with two small palpi shaped like the antenna of a *Tabanus*.

Legs orange-yellow, with short pubescence. Posterior tibiæ brownish; tarsi brown, middle tarsi (except metatarsus) black.

Fore femora with the enlargement below bearing a strong spine before the middle, followed by two or three smaller ones on a small bump, and thence to the tip by several short ones. Hairs on upper side of fore femora rather stronger than in most species. Fore tibia widened behind up to the middle, where it is somewhat contracted, and again at three-fourths of its length; the basal half of the tibiæ bearing three or four strong short spines.

Middle femora with a bristle on the front side, in the middle; middle tibiæ with two bristles on outside, one behind and several at the tip. Hind femora with two on the outside in the middle and some at the tip. All the tarsi pubescent below, with rows of spines; fore metatarsus below with a thick fringe of bristly hair; hind metatarsus below with two stronger spines at its base.

Wings clear, with a distinct, generally round (but sometimes irregular) brownish spot at tip of second vein; third and fourth veins converging just before the tip; inner cross-vein at two-fifths of the discal cell.

Described from several ♂ ♂ in the Indian Museum collection with the following data: Darjiling, 26-ix-08 [*Brunetti*]; Phagu (9,000 ft), 11-v-09 [*Annandale*]; Simla (7,000 ft.), 16-v-09, on flowers of white stonecrop [*Annandale*]; Matiana (8,000 ft., Simla District), 28—30-iv-07 [*Annandale*]; Naini Tal (6—7,000 ft.) [*Lloyd*]; and 5-vi-09 [*Ind. Mus. Coll.*]. A ♂ in the Pusa collection taken by Mr. Howlett at Simla in x-08.

N.B.—A very distinct and rather handsome species somewhat allied to *rufibasis*. Its black dorsum and yellow sides, to at least the front part of the thorax, will separate it from all my species with a wing spot, except *rufipectus*, from which it is, however, distinguished by its larger size, superior robustness, and usually round-shaped wing spot.

Sepsis violacea, Mg.

Five females taken by me at Shanghai, 16-iv-06, appear to be this European species, although they do not quite agree either with the description, or with specimens from Europe. The ♂

taken by me the same day at Shanghai, and which I dubiously refer to *punctum*, F., may possibly be the ♂ of *violacea*, as I have never seen that sex of this species, and two other ♂ ♂ taken with them (now in the Indian Museum) more nearly approximate to what I should expect *violacea*, ♂, to be like. I have never seen a ♂ *violacea* or a ♀ *punctum*.

Sepsis flava, mihi, sp. nov

(Plate xiii, figs. 4, 5.)

♂. India. Long. 2—3 mm.

Head.—Frons, face, back of head, proboscis, mouth, under side of head and antennæ wholly orange-yellow. Upper side of antennæ sometimes a little darker, and there is sometimes a blackish irregular line across the back of the head, just below the vertex.

The ocelli are placed on three small black spots, between which emerge two bristles. Three pairs of bristles occur along the vertex, one in the centre, and one behind the corner of each eye.

Thorax normally entirely orange-yellow, sometimes an irregular darker part or streak or two on dorsum. Four dorso-central bristles. Scutellum concolorous, a stiff bristle near fore border in front of each spine.

Abdomen reddish orange; the extreme base, the posterior border of second segment, and more or less of the third and fourth segments, blackish. Tip of abdomen, orange-yellow. The black colour varies considerably in intensity and extent, sometimes being reduced to the posterior half of the third segment, with a little on the fourth and fifth, and sometimes covering all the abdomen except the basal half of the second and the abdomen tip. The whole abdomen is covered with scattered, stiff hairs, including a more or less regular row near the posterior border of each segment. These are much longer than in any of my previously described species, and are almost as long as the usual pairs of spiny bristles towards the sides of the second to the fifth segments. Genitalia large and conspicuous, orange-yellow, with stiff hairs.

Legs.—Front pair entirely yellow, with soft hairs; femora with a large enlargement on basal half below, bearing five or six black spines of different lengths; tibiæ widened on apical half, this half being contracted in the middle and bare, whilst the basal half bears a row of short stout spines Posterior legs yellow, with soft black pubescence; the basal half of the tibiæ and towards the tarsi tips, more or less brownish. Middle femora with a few spiny bristles below, about the middle; the hind pair with a bristle or two, apparently irregularly placed. Middle tibiæ with a row of spines behind, one on the outer side in the middle and a few at the tip. Hind tibiæ with a few on the apical half, irregularly placed on the outer and hinder sides. All the tarsi with short

hairs and some bristles; hind metatarsus bearing at extreme base a row of four strong spines close together, followed by a further row of several others, wider apart, along its whole length.

Wings clear; wing spot of considerably variable size and intensity, often reduced to a small brownish oval suffusion, or almost a mere dash at tip of second vein; third and fourth veins parallel, not diverging at tips. Inner cross-vein at a little beyond middle of discal cell. Basal cells united, through the absence of the intermediate veinlet. Veins yellowish brown.

Described from several ♂ ♂ in the Indian Museum collection, bearing the following data: Calcutta, 14-vi-07, 11-vii-07, 25-v-09. Jalpaiguri, 1-vii-08 (in railway carriage); Puri, 18-i-08 [*Annandale*]. Rajmahal, 5-vii-09 [*Annandale*]; Tinpahar, near Rajmahal, Bengal, 7-vii-09. Allahabad, 12-viii-09 [*Lord*]. Also from six specimens in the Pusa collection taken at that place on shrubs and manure, 29-v-06, 29-vi-07, 1-vii-07, 27-vii-07.

N.B.—The amount of black in both thorax and abdomen is very variable, especially in the latter. In one specimen from Puri, Bengal, the whole thorax is brownish; and in another from the same locality there are traces of four dorsal blackish stripes. A specimen in my collection taken by me at Jhansi, 2-viii-05, is similarly marked, and has in addition several additional strong spiny bristles on the posterior part of the thorax. Yet I have no doubt both specimens belong to this species.

Sepsis rufipectus, mihi, sp. nov.

♀. India. Long. 2¼ mm.

Head.—Frons brown, black about the vertex and on back of head. Face, cheeks and antennæ light yellow ochre; mouth border narrowly black; proboscis brown.

Thorax (slightly injured).—Dorsum shining black, apparently four dorso-central bristles. Sides shining black; shoulders reddish yellow, the colour spreading immediately downwards to the lower part of the thorax and carried forward below in front. Sternopleura shining black; no signs of grey dust. Scutellum and metanotum blackish, moderately shining.

Abdomen shining black to the tip; base at sides a little light brownish. Apparently no large spiny bristles, but towards posterior border of third, fourth and fifth segments, a row of somewhat stronger bristly hairs than the general pubescence of the abdomen. Genitalia small, shining black, with some hairs.

Legs yellow, with soft pubescence; middle tibiæ nearly to the tip, hind tibiæ wholly, and the apical half of all the tarsi, rather dark brown. Fore femora with a few bristly hairs below, near the base. Posterior femora apparently unspined. Middle tibiæ with a bristle on inner side, about the middle; hind tibiæ (of the unique specimen) do not possess any bristles but they have probably been accidentally broken off. All tarsi with bristles below, longest on fore pair, two spines at base of hind metatarsus.

Wings clear; spot fairly well defined, but without clear-cut edges, brownish, oval. Inner cross-vein at just beyond middle of discal cell.

Described from a single ♀ in the ndian Museum collection, labelled Bhogaon (West Bengal), 6-x-08 [*Paiva*].

N.B.—Several specimens of both sexes in the above collection may represent varieties of this species, or further additional ones,

Sepsis tincta, mihi, sp. nov.

(**Plate xiii**, figs. 6, 7.)

♂ ♀. India. Long. 2¼—2½ mm.

Head.—Frons shining black. Face, mouth, proboscis, lower part of head and lower part of ocular orbit, reddish yellow to reddish brown, the colour often extending to just above the antennæ, which are reddish yellow to reddish grey, the basal part and the upper side of third joint more or less blackish.

Thorax blackish, shining, no tinge of any other colour. Four conspicuous dorso-central bristles. Sternopleura shining black.

Abdomen shining black. The second segment (which sometimes is faintly pale at sides or on posterior border) is barely humped up in the ♂, as in most species. Moreover it is somewhat attenuated in the ♂, and the whole abdomen in this sex is somewhat narrower than usual. There are in one specimen two or three rather small spiny bristles on the fourth and fifth segments, but in the remainder they are absent, although some of the bristly hairs occurring in the spots where the spines usually occur, are somewhat longer than those scattered over the entire abdomen. Practically it is a species bare of abdominal spiny bristles. Genitalia very large and conspicuous in the ♂, triangular in shape, shining black; in the ♀ very small and pointed, or withdrawn.

Legs.—Coxæ yellow, fore pair wholly so, paler; posterior coxæ reddish yellow, blackish on basal portion.

Fore femora reddish yellow, with upper side more or less blackish, the variation in colour being considerable. On the under side is an enlargement (narrowing towards and at the tip), which bears two large spines, with a smaller one between them, also, just beyond (on a small elevation) two small spines. There are two or three bristles at the base.

Fore tibia (♂) narrow on basal half, with a row of short spines on inner side, extending nearly to the middle, where, to the end, the tibia suddenly widens considerably, but is bare; in the ♀ the difference in width is inconspicuous, the tibia gradually widening.

Posterior femora and tibiæ black, the former always narrowly pale at base, the middle tibiæ slightly pale at tips. Knees rarely, narrowly pale.

The femora are apparently bare of spiny bristles, the middle tibiæ bear two in the middle (outside and behind), with some at

the tip; the hind tibiæ have two similarly placed about the middle, but none at the tip.

All the tarsi minutely spined below, with larger ones intermixed, hind metatarsi with three strong spines of uneven length, below at base. All tarsi dirty yellow, blackish towards tips.

Wings practically clear, wing spot in the form of a distinct suffusion at the end of the second vein, and diminishing gradually posteriorly, its extent varying in different specimens, sometimes to the third longitudinal vein, or, in one example, almost to the hind border of the wing. The third and fourth veins are slightly tinged, as though thickened, immediately in a line behind the suffusion, and they are more nearly parallel than in *lineatipes*. The inner cross-vein at just beyond the middle of the discal cell. The basal cells are united, by reason of the absence of the usual intermediate vein. Halteres yellow.

Described from three ♂ ♂ and six ♀ ♀ in the Indian Museum collection, all from localities in India.

LOCS.—Puri (Orissa, East Coast), 18—19-i-08; Jalpaiguri, 1-vii-08, in railway carriage; Shencottah (South India), 25-xi-08 [all *Annandale*]; Calcutta, 29-v-07, 17-vii-07, 1-vi-07 [*Annandale, Paiva, Caunter*]; between Bolpore and Rampore Haut (Bengal), at light in railway carriage, 3-viii-07 [*Paiva*]; Katihar (Bengal), 24-iii-09, one ♀ [*Paiva*]; Rajmahal (Bengal), 5-vii-09 [*Annandale*]; Sitarampore, Bengal, 10-viii-09 [*Lord*]; Dhikala, 9-v-09; Jumnogwar, 14-v-09, both in the Garhwal District, Western Himalayas; Tinpahar (Bengal), 7-vii-09; Unchagaon (plains of Naini Tal District), 7-iv-09; Allahabad, 15-viii-09 [*Lord*]. In the Pusa collection, from Pusa, 14-xii-07 and v-08.

N.B.—Although near to *lineatipes*, this species is very distinct, and may be at once distinguished by the shining black sternopleura, the attenuated second abdominal segment in the ♂, the practical absence of spines on the abdomen, the almost wholly black posterior femora, the large ♂. genitalia, the differently shaped fore femora in the ♂, and by the darkened wing mark, which always appears as a *suffusion*, gradually dying away posteriorly, instead of a fairly distinct *spot*, although tolerably faint, and with ill-defined but roughly circular outline. Moreover, the present species seems to occur in the plains only, whereas *lineatipes* I only know from Darjiling.

Sepsis lineatipes, mihi, sp. nov.

♂. Darjiling. Long. 2½—3 mm.

Head.—Frons shining black, with a tendency to change just above the antennæ to the reddish brown colour of the face and mouth. On each side of the mouth, a narrow black stripe, on which is placed the usual row of bristles. Proboscis reddish yellow. Antennæ black, the whole under side of third joint reddish yellow.

Thorax black, with a slight dark green tinge. Four dorso-central bristles.[1] Sternopleura grey dusted.

Abdomen shining violet-black, second segment at sides and above *sometimes* with a reddish brown o violet-brown tint, but sometimes entirely violet-black. Tip of abdomen (sixth segment) yellowish in one specimen, which has the apical half of the abdomen of a greenish bronze tint. Second segment with two or three rather small but distinct bristles towards the sides, third, fourth and fifth segments with a strong bristle towards the side of each, sixth segment with some bristly hairs.

Legs yellow; all the femora with a black streak on upper side, which on the fore pair becomes more or less diffused over the sides. Fore femora with under side as in *punctum*, posterior femora apparently without spines, except one in the middle of the middle pair in front. Middle tibiæ on basal half and hind tibiæ wholly black. The middle pair with three or four spiny bristles on the outer side, also one in the middle, in front, and three at the tip. Hind tibiæ with two or three similar bristles about the middle, on outer and hinder sides. Tarsi dirty yellow, with short, spiny bristles below, black towards tips.

Wings nearly clear, the spot rather indistinct but roughly circular, and always of the nature of a "spot" and not a "suffusion." Inner cross-vein at about two fifths of the discal cell.

Described from five ♂ ♂ in the Indian Museum collection taken by me at Darjiling, 24-ix—2-x 08, in fields.

N.B.—A variable species in the colour of the abdomen, at base and tip, and to a less degree in that of the legs also, but the black streaked femora, in conjunction with the nature of the wing spot and the reddishness of the face extending above the antennæ, will distinguish it. I have no doubt whatever that the five examples represent but a single species.

Sepsis dissimilis, mihi, sp. nov.

(**Plate xiii**, fig. 8.)

♂ ♀. India. Long. 1½—2 mm.

Head, ♂, entirely yellow, frons reddish yellow, vertex round, ocelli blackish, antennæ reddish yellow, eyes black; ♀, frons blackish, with reddish marks, antennæ darker, back of head black.

Thorax, ♂, in one specimen wholly reddish yellow, with a dusky dorsum which is slightly darker on the posterior part; in the other ♂, dull reddish yellow with two blackish ill-defined stripes towards the sides. Sternopleuræ reddish yellow, a little grey dusted. ♀, wholly shining black, including the sternopleuræ. Sides of thorax reddish in front below the shoulders. Scutellum brownish yellow (♂), or black (♀). Four distinct and large dorso-central bristles in both sexes.

[1] These are not fully present in any one specimen, but in two or three there are certain traces of them having been present, and in at least one specimen, a single bristle (rather short) of the anterior pair is still intact.

Abdomen, ♂, reddish yellow, dorsum, especially of the third and fourth segments, violet-black, fifth yellow. ♀, wholly violet-black, tip greenish, shining.

In the ♂ the third, fourth and fifth segments each bears a pair of strong bristles towards the posterior border, but they are not visible in the ♀ (the ♀ specimen is in equally good condition as the ♂).

Legs (middle pair wanting in ♂) yellow, posterior tibiæ brownish; tips of tarsi black; coxæ in ♂ pale yellow; posterior femora in ♀ brownish towards tips. Fore femora in ♂ enlarged with a bump in the middle, below, bearing three short spines. A single strong long spine precedes the bump, which is followed by the leaf-shaped appendage bearing a short spine. A little black hair at the base, on he inside of the fore femora, and a strong spine on the outer side, in the middle. Fore tibiæ (♂) contracted at base and middle, with a few bristles on basal half. Posterior femora apparently bare of bristles; posterior tibiæ with a few bristles on apical half.

Wings as in *tincta*; inner cross-vein distinctly beyond middle of discal cell; two basal cells distinctly separated.

Described from a pair *in cop.* and an additional ♂ taken at Shasthancottah, 12 miles N.N.E. of Quilon, South India, by Dr. Annandale, 8-xi-08; a ♂ from Rajmahal, Bengal, 5-vii-09 [*Annandale*]; and a ♂ from the Garhwal District, Western Himalayas, 9-v-09.

N.B.—This species is the only one seen by me in which so much difference appears in the sexes, and but for Dr. Annandale's assurance that they were personally taken *in cop.* by him, I should have regarded them as distinct. The species is near both *flava* (♂) and *coprophila* (♀) but may be distinguished from *each by the basal cells being distinctly separate, instead of* united. I know of no species in which the abdominal strong bristles are present in the ♂ only, yet there is no trace of any in the type ♀ of this species, which specimen is in as equally good condition as the ♂.

Sepsis dilata, mihi, sp. nov.

? ♂. Bengal. Long. 2¾ mm. barely.

Head.—Frons and back of head black; antennæ, face, proboscis and lower part of head, reddish.

Thorax black, two dorso-central bristles, curved inwards at tip. The two scutellar bristles rather close together, long, somewhat erect and waved. Sides of thorax, especially towards the front, slightly dark brown. Sternopleuræ not white dusted.

Abdomen shining black, with soft hairs only.

Legs.—Fore pair yellow, posterior legs reddish, hind femora slightly brownish, hind tibiæ black, also tips of tarsi, and hind metatarsi, the latter with a few large spines below at base. *Hind tibiæ distinctly dilated on apical half.* Middle femora with a bristle in the middle in front and a row of short stiff hairs below near tip; middle tibiæ with a bristle on inner and on hinder sides towards tip.

Wings clear, but with a distinctly perceptible but rather faint suffusion at tip of second vein. Inner cross-vein at middle of discal cell; basal cells distinctly united; third and fourth veins parallel.

Described from one example in the Pusa collection taken at Pusa, on tobacco, 22-iii-06.

N.B.—The fore femora are somewhat flattened and distorted, evidently by accident, and it is rather difficult to determine the sex, but from their apparent depth I believe the specimen to be a ♂. No spines or bumps are visible on the fore femora, the tibiæ of which are simple. The *dilated hind tibiæ* will easily distinguish this species from all others known from the East.

This species is the only one I have seen which causes any doubt as to whether to include it in the "wing spotted" or "wing clear" division of the genus. As in some of the specimens of both my *tincta* and my *flava*, the spot becomes much fainter than usual, though always distinctly present, I include the species in the "wing spotted" division.

Sepsis indica, Wied.

(*Nemopoda fusciventris*, Big., *nom. nud.*, in Indian Museum collection.)

Herr Meijere classed this species with the unrecognisable ones of the older authors. Having identified a good series from South India to my satisfaction with this species, specimens were sent for comparison with the type to the Vienna Museum, where they were kindly confirmed by Herr Handlirsch as correctly named. I therefore redescribe it at some length from the good series of freshly captured specimens in the Indian Museum, because it must be taken as the typical form of a group of more or less common Oriental species; its nearest allies being *rufa*, Mg., and *trivittata*, Big., from which the differences are noted in my redescription. It is evidently widely distributed in the East, and appears in the Indian Museum from the following localities:—

Calcutta, 15-xi—xii-06 [*Brunetti*]; 29-iv-07, 30-ix-07, 8-x-07 [*Caunter*]; Rajmahal (Bengal), 31-vii-07; Sadiya (Assam); Rungpo (Sikhim), 1,400 ft., 6-ix-09; Maddathorai, 19-xi-08, and Pallode, 15-xi-08 (both South India, taken by Dr. Annandale; at the latter place he found it swarming on dung). Tinpahar (near Rajmahal, Bengal), 7-vii-09; Goalbathan, East Bengal, 9-vii-09. Also in my collection from Calcutta.

Redescription.

(Plate xiii, figs. 9—13.)

♂ ♀. India and the Orient. Long. 3 to nearly 5 mm.

***Head.*—Frons, face and antennæ vary from lighting reddish yellow to nearly black; second joint of antennæ with fairly long**

bristle. Proboscis yellow. Back of head reddish yellow, blackish towards vertex, some bristles in the centre, behind.

Thorax normally, wholly reddish yellow, with a broad black dorsal stripe which varies very considerably in width, sometimes occupying the greater part of the dorsum and being of uniform width throughout, sometimes reduced to a much narrower stripe, which narrows still more at the anterior margin. What I consider the typical form are those examples with a fairly wide stripe of equal width. Sides of thorax with a rather broad greyish white shimmering band across the sternopleuræ, extending narrowly to the pectoral corners. *Beneath* this grey shimmer, and shining through it, the ground colour on this part is in some specimens black, the sternopleuræ bearing also in these a small black streak on each side, towards the front. Four strong dorso-central bristles. Two rows of distinct, short bristles extend from them almost to the anterior margin, the first in each row (contiguous to the anterior pair of dorso-central ones) being considerably larger than the remainder. A third longitudinal row of minute bristles occurs in the middle of the dorsum. Scutellum and metanotum reddish yellow.

Abdomen normally, reddish yellow, more or less irregularly marked with black, which sometimes occurs as a dorsal stripe, sometimes as large spots on the segment, sometimes occupies nearly the whole abdomen. Third, fourth and fifth segment with four strong spiny bristles, the two outer ones on the fifth segment being placed at the sides. Second segment generally with two bunches of bristly hairs at each side, the hinder bunch the stronger. Genitalia reddish yellow, with two strong bristles, rather large and complicated.

Legs reddish yellow; fore pair paler, hind tibiæ dark brown, and all the tarsi black towards the tips. Fore femora not so thickened as in many species, lightly pubescent, bearing a peg-like bump below, in the middle (which bears three or four short spines), followed by the leaf-shaped appendage. There are no strong spines on the fore femora below, but three or four stiff hairs towards the tips, and two or three spiny bristles above, near tip. Fore tibiæ slightly enlarged just beyond the base, and again on apical half, which latter bears a row of stiff very short, spiny bristles towards the outer side and for the *whole length of the apical half of the tibia. The basal half of the fore tibia is entirely bare of* bristles or spines. Fore metatarsi with two long black spines below at base, and some yellowish red pubescence. Posterior femora with no conspicuous bristles, but one or two at tip above, on the middle pair, and a few small ones on hind pair above at tip. Middle tibiæ sometimes blackish towards the base, with three or four insignificant bristles in the neighbourhood of the middle, one on the outer and two on the hinder side, also a few at the extreme tip. Hind tibiæ with normally, two on hinder side on apical half, and one on outer side just below the middle.

Wings clear; fourth longitudinal vein rather bowed, but parallel to the third towards tip.

Described from numerous ♂ ♂ and ♀ ♀ in the Indian Museum, captured by Dr. Annandale in South India. Other specimens in the Museum collection, and in my own from various Oriental localities, agree with the species. The South India series show all varieties, were very common on dung, and were examined and described soon after capture when in perfect condition.

This species is nearest to *trivittata*, Bigot, and *rufa*, Macq. The former is recognised by the wholly red-yellow thoracic dorsum, in conjunction with the very spiny legs. *Rufa*, Macq., is nearest to *indica*, but the fore legs will always at least distinguish the males. In *indica* the fore femora are only slightly thickened, there are no separate strong spines below before the bump, which latter takes the form of a rather elongated peg, and the fore tibiæ are bare at the base and possess a row of bristles on apical half.

In *rufa* the fore femora are considerably thickened, with two strong spines just before the bump, which is short, fan-shaped, with four or five short spines; the fore tibiæ have a short row of bristles near the base, the apical half being bare.

Sepsis trivittata, Big.

Males of this species are in the Indian Museum from Margherita (Assam); Rangoon, 24-ii-08 [*Annandale*]; Pallode, 15-xi-08, and Maddathorai, 19-xi-08 [both South India, *Annandale*]. In the Pusa collection from Pusa, 15-vii-07.

Sepsis rufa, Macq.

Both sexes in the Indian Museum from Tharbani (Nepal), 27-ii-08; Gangtok, Sikhim (6,100 ft.), 9-ix-09; Shillong; Mandalay, 12-iii-08 [*Annandale*]; Rangoon, 24-ii-08 [*Annandale*]; Darjiling, 7,000 ft., 28-ix-08 [*Brunetti*]; Kurseong, 5,000 ft., 3—9-vii-08 [*Annandale*]; Calcutta, 20-ii-07, 17-ix-07, 28-x-07, 27-xi-07; Puri, 18-i-08 [*Annandale*]; Bhogaon, 6-x-08 [*Paiva*]. Katihar (Bengal), common, 23—26-iii-09 [*Paiva*]; Tinpahar (Bengal), 7-vii-09. Taken also by Mr Howlett at Simla in October 1908, and I have seen it from Pusa, 29-v-06.

The dark variety mentioned by Herr Meijere (Ann. Mus. Hung., iv, 182) with all-black thorax (with or without a more or less distinct dark red side-stripe), second abdominal segment often with two slightly yellowish marks, dark red-brown frons and posterior femora often only streaked above with black, was common at Katihar (Purneah District, Bengal), 23—26-iii-09 [*Paiva*]. The males are easily recognised from those of *coprophila*, Meij., by the fore femora, but the females of this variety approximate very closely to those of *coprophila*. The variety is smaller than the typical form.

Sepsis spectabilis, Meij.

Specimens of both sexes collected by Dr. Annandale at Maddathorai, 18-xi-08, Pallode, 15-xi-08, and Nedumangad, 14-xi-08 (all Travancore, South India), are certainly referable to this species, and agree very well with specimens named by Meijere. I have a ♀ in my own collection which I took at Penang, 3—8-viii-06; and two specimens taken by me in Calcutta, 6-x-04 and 6-iii-05. It is a somewhat variable species, as stated by its author.

Sepsis brevicosta, mihi, sp. nov.

♂ ♀. India. Long. 3 mm.

This species is very closely allied to *spectabilis*, Meij., and for some time I regarded it as a variety of that species, especially as I had seen no ♂ that I could join with the ♀ form. However, a ♂ captured recently in Calcutta agrees so well that I am constrained to believe it to be this species.

The fore femora are not easily seen in the specimen, but they are fairly strongly thickened on the basal two-thirds, and bear a strong spine some distance from the base, a small bump with three or four strong short spines, and possibly a further spine or two on the distal portion.

The fore tibiæ bear a short row of short spines at the base. In this species the dorsum of the thorax is much more covered with short black bristles than in *spectabilis*; and the sternopleura alone are blue-grey dusted, instead of this colour being carried forward as in Meijere's species.

The abdomen is wholly black, except the (usually) reddish basal portion of the second segment. Another and more striking peculiarity is the costal vein, which becomes suddenly so faint as to appear to terminate abruptly just beyond the second longitudinal vein. In nineteen specimens of true *spectabilis* examined by me (including a ♂ and two ♀ ♀ sent by Herr Meijere), this latter peculiarity is not present; yet I have seen it occasionally in specimens of *rufa*, Macq., and a tendency to it in two specimens I refer to the vicinity of my *rufipectus*. Moreover, the tip of the wing just below the apparent termination of the costa, is distinctly whitish, another character that I have not observed in *spectabilis*.

The two species are about equal in size, and *brevicosta* seems to be generally distributed in India.

The only ♂ I have seen comes from Calcutta, 28-v-09. Females are from Calcutta, 24—28-iv-09, Shencottah, 25-xi-08 [*Annandale*]; Tinpahar, Bengal, 7-vii-09. The Pusa collection has it from Pusa, 26-xi-08, taken on a manure heap at that place; also one from Lahore, May 1907. A ♀ in my collection was taken by me in Calcutta, 28-x-04.

Sepsis adjuncta, mihi, sp. nov.

(**Plate xiii,** fig. 14.)

♂. South India. Long. 3 mm.

This species is very closely allied to Herr Meijere's recently described *spectabilis*, ♂ ♀, from New Guinea and Singapore. The distinctly differently formed fore femora separate it; as in my species, this limb bears on a not very pronounced bump five or six short but strong black spines, whilst two longer and stronger spines are situated just before the bump. Meijere only mentions two spines, placed on the peg—not bump—and his figure is quite unlike the fore leg of my species; and on comparison with a ♂ and two ♀ ♀ (co-types) the species appears distinct.

The middle tibiæ have some spines on the inner side, and the middle femora three or four short but distinct spines on the front side, about the middle. The abdomen possesses a few bristles towards the side of the second segment, four distinct long bristles near the posterior edge of both third and fourth segments, two on the fifth and some bristly hairs on the genitalia, which in one specimen is almost entirely concealed.

The thorax bears very distinct short hairs over its entire surface; they are more numerous than in most species, whereas Meijere says his species is nearly bare on the thorax.

In all other respects my species agrees with *spectabilis*.

Described from two ♂ ♂ taken by Dr. Annandale at Pallode, 15-xi-08.

Sepsis brevis, mihi, sp. nov.

(**Platex** iii, fig. 15.)

♂. Central India. Long. 1½ mm.

Head wholly reddish yellow, including antennæ and proboscis; ocelli black.

Thorax rather broader and deeper than usual. Wholly reddish yellow, the dorsum with traces of black indistinct marks. Four dorso-central bristles. Scutellum black on under side.

Abdomen reddish yellow, marked irregularly with black; third segment with some bristly hairs on posterior border; fourth and fifth with a strong spiny bristle towards each side.

Legs wholly reddish yellow, practically to the tips. Fore femora below with a *thick row of strong black spines of irregular length*, and extending nearly the whole length of the femur. Fore tibiæ with a short row of strong, short, black spines on inner side at base. Middle tibiæ with three bristles behind, in the middle; one on inner side, in the middle, and a few at tip. Middle metatarsus with a row of well separated bristles below. Hind femora with a bristle above, near tip; hind tibiæ with bristles as on middle pair; hind tarsi bristly below, the metatarsus with four strong ones in a row at the base.

Wings clear; third and fourth veins parallel; inner cross-vein at middle of discal cell; basal cells united. Halteres reddish brown.

Described from a ♂ in the Pusa collection (type) and a second ♂ in the Indian Museum collection (co-type). Both specimens from Baroda, Central India, taken 1-iv-05.

N.B.—This is a well-marked species, distinguishable by its rather short and thick-set appearance, and easily identified by the conspicuous row of spines on the fore femora, which latter are thickened but without any bumps or peg-like protuberances. The species is in general appearance something like my *flava*, but will be grouped as a somewhat abnormal one with the *indica* set of species, coming nearest to Herr Meijere's *tenella*.

Sepsis tenella, Meij.

Specimens that I can refer without doubt to this species (♂ ♂ only) occur in the Museum collection from Sylhet, 15-v-05 [*Hall*]; Chittagong, 5-viii—21-ix-08 [*Hall*]; Sukna (base of Darjiling Hills), 1-vii-08 [*Annandale*]; Tinpahar (Bengal), 7-vii 09; Rajmahal (Bengal), on cowdung, 5-vii-09 [*Annandale*]; Trivandrum (S. India), 12-xi-08 [*Annandale*].

Sepsis coprophila, Meij.

The Indian Museum possesses this species from Darjiling, 9-viii-09; Calcutta, 16-iii-07, 5-viii-08, 23—31-x-07; Barrackpore (near Calcutta), 1-viii-09; Pallode (S. India), 15-xi-08; Rangoon, 24-ii-08; Mandalay, 12-iii-08 [all *Annandale*]; Bhogaon (Bengal), 6—20-viii-07 and 2—6-x-08; also Katihar (Purneah District, Bengal), 23-iii-09, five ♀ ♀ [both *Paiva*]; Tinpahar (near Rajmahal, Bengal), three ♂ ♂, two ♀ ♀, 7-vii-09; Batavia, xi-07, and Samarang (Java), i-06 [both *Jacobson*].

In my collection I have it from Peradeniya, Ceylon, xi-07 [*Green*].

N.B.—The variety mentioned by the author of the species, with reddish sides to the thorax, bears considerable resemblance to my *fulvolateralis*, from which, of course, the clear wings separate it. In one ♂ the second basal cell is merged in the first, through the absence of the intervening veinlet; this irregularity, by the way, occurs occasionally in other species. This form approximates closely to the small dark form of *rufa*, Mcq., and the females are often difficult to distinguish.

Sepsis humeralis, mihi, sp. nov.

♂ ♀. Simla. Long. 3—3½ mm.

Head ♂.—Frons and antennæ black; under side of head reddish brown, back of head blackish.

Thorax blackish; two dorso-central bristles. Sides blackish, mesopleura shining black, sternopleura barely dusted. Humeral

cells and sides of thorax below them, and the whole prothorax below, red-brown. Scutellum blackish, tip reddish brown.

Abdomen blackish, with a violet tinge; a little reddish at base of second segment. No strong bristles, but a row of rather longer hairs on the posterior border of third and fourth segments, the fifth bearing numerous long hairs. Abdomen rather swollen towards tip; genitalia concealed, but apparently of large size and complicated form.

Legs.—Coxæ reddish brown, front pair pale yellow towards tips. Fore femora brownish yellow, bases and tips paler, with a *row of about 12 strong bristles* below, extending nearly all the length of the limb, and diminishing in size towards the tip. A single long stiff hair at the base. Fore tibiæ pale yellow, with a row of short black spines on inner side, extending well beyond the middle. Fore metatarsi brown with golden yellow pubescence below; rest of fore tarsi black. (Middle legs missing.) Hind femora blackish brown, pale at tips, with some stiff hairs below; hind tibiæ black.

Wings clear; third and fourth longitudinal veins nearly parallel; inner cross-vein at three-fifths of the discal cell.

Described from one perfect ♂ (except for the absence of middle legs) in the Pusa collection taken by Mr. Howlett at Simla in October 1908, and a ♀ in my collection from Hongkong, 4-iii-06. Another ♀ example was taken by Mr. Howlett at Simla in October 1908. The face, antennæ and frons just above them are all reddish brown, the back of the head yellowish. There are four dorso-central spines; two strong bristles on the third, and four on the fourth abdominal segment. The legs are nearly all yellow, the middle femora slightly brown; the middle tibiæ bear a few bristles, and the hind femora possess no stiff hairs below. I can only presume the abdominal bristles have been broken off in the ♂ specimen, leaving no trace, as the examples are so similar, and from the same locality.

N.B.—In a headless specimen in the Indian Museum collection taken by me at Shanghai, 16-iv-06 (the head was present when I first identified it with this species), the legs are nearly all yellow as in the above ♀. The specimen also shows the bulged abdomen at tip, and also has no spines on the abdomen. I cannot, however, suggest that the spines are a sexual character.

Sepsis nepalensis, mihi, sp. nov.

♀. Nepal. Long. 4¼ mm.

Head.—**Frons and back of head shining black, mouth black. Lower part of head yellowish; antennæ dull reddish yellow, third joint cinereous grey dusted. Face brownish yellow (probably variable), with a slight violet-grey dust along the cheeks; proboscis brownish yellow.**

Thorax.—**Dorsum dark olive-green, four dorso-central bristles. Sides shining blue-black, shoulders bright yellow. Sternopleuræ**

wholly and conspicuously pale bluish-grey dusted, whilst there is also a distinct bluish grey narrow line just below the dorsum of the thorax, passing above the humeral yellow spot. Mesopleura shining aënous black; scutellum with posterior half reddish yellow, as are also the hind corners of the thoracic dorsum.

Abdomen shining violet-black; first two segments black, with some soft hairs towards the sides of the second. Third segment without spines (? broken off), fourth and fifth with four spines each, towards posterior border; some bristles about the tip of the abdomen. Whole abdomen with soft hairs.

Legs wholly yellow, with a faint indication of brownish on upper side of hind femora; last three tarsal joints black. Hind femora with two bristles above, near tip; middle tibiæ with some bristles on lower half and at tip; hind tibiæ with two on outer side beyond the middle.

Wings clear; inner cross-vein at three-fifths of the discal cell.

Described from a single perfect unique ♀ taken at Nagarkote, Nepal. Indian Museum collection.

Sepsis bicolor, Wied.

(*S. javanica*, Meij.)

Wiedemann's description of this species is very brief, but specimens thus identified by me sent to both Herr Meijere and to the Vienna Museum have been confirmed as correctly determined; by the former as identical with his *javanica*, and by Herr Handlirsch at Vienna as identical with *bicolor*, W., after comparison with the type.

This species extends over a considerable region of the Orient, the Indian Museum possessing it from the following localities:—

Thamaspur, 18-ii-08, Benikhola, 17-ii-08, and Sarah, 24-ii-08 (all Nepal); Sylhet, 20-ii-05, 3—10-v-05 [*Hall*]; Gangtok, Sikhim, 9-ix-09; Kurseong, 5,000 ft., 5-vii-08, 10—26-ix-09; Darjiling, 2-x-08 [*Brunetti*], 6-viii-09; Simla, 7,000 ft., 11-v-08; and 10-v-09 on flowers of white stonecrop; Naini Tal (6,000 ft.), 2-vi-09. Calcutta, 2-viii—12-ix; (occurs "at light") Rangoon, 24-ii-08 [all *Annandale*]; Bhogaon, 6-x-08, Katihar (Bengal), 23-iii-09 [*Paiva*]; Tinpahar (Bengal), 7-vii-09; Rajmahal (Bengal), 5-vii-09 [*Annandale*]. On board launch (at light), Mud Point, Hooghly R. [*Jenkins*].

Dr. Annandale found both sexes common in South India during November 1908, the localities being Shasthancottah, Trivandrum, Pallode, Tenmalai and Maddathorai (all Travancore State). Amongst these, several specimens of both sexes show traces of reddish colour on the sides of the thorax, this variation being mentioned by Herr Meijere in his description of *javanica*. In the Pusa collection it figures from Pusa, ii and 7-xii-08; also from the outskirts of Calcutta, 13-iii-08.

Sepsis pubipes, mihi, sp. nov.

(Plate xiii, figs. 16—18.)

♂. Nepal and Sikhim. Long. 2½—3 mm.

Head shining black, antennæ reddish.

Thorax blackish; four dorso-central bristles. Sternopleura distinctly grey dusted, the grey dust extending forwards narrowly, and hindwards more broadly. Scutellum and metanotum shining black.

Abdomen shining violet-black, with soft pubescence, under side occasionally a little pale. Second segment somewhat elongated and contracted a little at tip. Dorsum apparently without prominent strong bristles, but there are two on the large, black genitalia, which are more conspicuous in some specimens than in others.

Legs yellow, with soft black hairs. Hind femora and tarsi tips brown. Fore femora somewhat considerably enlarged below, with three small spines on a bump placed about the middle, and four long spines in a row towards the tip, and verging round somewhat towards the outer side of the femur. Fore tibiæ swollen on lower side about the middle and again towards the tip, bearing four long spines between the base and the first swelling (verging round somewhat towards the inner side), and several smaller ones on the second swelling. Fore tarsi with bristly hair below.

Femora without bristles. Middle tibiæ with rather close rows of long black bristly stiff hairs on inner side, which contain also a row of a few strong bristles; the outer sides of this pair of tibiæ being quite bare. Middle metatarsi with four rows of stout bristles placed on the outer, inner, front and hinder sides respectively, those on the front side being the strongest; rest of tarsus with bristly hair below.

Hind tibiæ covered with rather close black hairs except on the inner side: hind metatarsus with a single row of long stiff bristles below, a row of much smaller ones on the outer side, and a fringe of very short golden pubescence below; rest of tarsus with short bristles below.

Wings clear; inner cross-vein at about two-fifths of the discal cell; third and fourth veins parallel.

Described from four ♂ ♂ in the Indian Museum collection taken at Thamaspur, Nepal, 18—20-ii-08, and one ♂ from Shamdang, Sikhim (3,000 ft.), 7-ix-09.

N.B.—The most distinct species of any described here, for although it is of normal appearance, the thick bristly hair on the posterior legs will distinguish it at once from all others known to me.

Sepsis fasciculata, mihi, sp. nov.

♂. Ceylon; Calcutta. Long. 2¼ mm.

Head.—Frons shining black, with a *pair of additional bristles*, placed midway between those springing from amid the ocelli, and

the antennæ, and situated at the extreme edge of the frons, touching the eyes. Face black, with a perpendicular reddish stripe just below the antennæ, which are reddish, with the upper side a little blackish. Under side and the rather bristly proboscis reddish. Back of head shining black.

Thorax blackish (posterior part of dorsum injured by the pin), apparently four dorso-central bristles. Sternopleura *grey dusted only above*; mesopleura shining black; scutellum blackish.

Abdomen shining black. Second segment with several strong bristly hairs towards sides; third and fourth with the usual pair each, which are hardly larger than the bristly hairs which are scattered over the whole dorsum, intermixed with hairs of various lengths.

Genitalia shining brownish black; very large, conspicuous and of peculiar shape, elongated, thick, with two long palp-like organs at the tip; with two stiff bristles at the extreme base above, and with generally scattered hairs. The *fourth abdominal segment is drawn out below and carries a bunch of long, ciliated filaments*

Legs mainly yellow. Fore femora only slightly enlarged below on basal half, where is placed a stiff long bristle, followed by a strong spine. In the middle of the under side is another strong spine followed by a much wider, shorter and slightly curved one. The *fore tibiæ* are narrow for the basal half and then *suddenly widened to double their width.* A single spine is placed on the inner side of the basal half; the rest of the tibia bearing (with the fore femora) short hairs, as is the case with all the legs.

Posterior femora without spines or strong bristles, the apical half mainly blackish. Posterior tibiæ mainly blackish, without spines, even at tips. All the tarsi blackish towards tips, with a *row of short, strong bristles below, intermixed on all the tarsi* with short, thick, golden yellow pubescence below, the hind pair bearing also a pair of small spines at the base, below.

Wings clear; inner cross-vein at only just beyond middle of discal cell.

Described from two ♂ ♂; one (now the type) is in my own collection sent me by Mr. E. E. Green from Ceylon; the other was in the Indian Museum collection from Calcutta, 16-vi-07, but was accidentally destroyed.

Sepsis viduata, Thoms.

Nemopoda formiciodes, Big., *nom. nud.*, in Indian Museum.

This species is commonly distributed over the East, but appears more rarely in the hills.

LOCS.—Sukna (E. Himalayas, 500 ft.), 1-vii-08 [*Annandale*]; Berhampur (Bengal), 1-i-08 [*Lloyd*]; Calcutta, 29-v-07, 10-viii—31-x; Maddathorai, 18-xi-08, and Pallode, 15-xi-08 [*Annandale*]; Rangoon, 25-ii-08 [*Annandale*]; Margherita (Assam), Batavia, x-07 [*Jacobson*]. The above localities are represented in the Indian

Museum, whilst I have taken it myself at Rangoon, 18-viii-06, Manila, 13-iii-06, Soerabaya (Java) and Mussoorie, these being in my own collection. Thomson recorded it from China.

It is an easily recognised species, from its larger size (5—6 mm.), dull black colour, the abdomen bearing whitish cross-bands; its whole appearance resembling that of an ant.

Enicita annulipes, Meig.

This common European species is quite common at most of the Himalayan hill stations, but it does not appear to frequent the plains except occasionally close to the base of the Himalayas.

Locs.—Simla (7,000 ft.), 24-iv-07, 6-v-07, 12-v-08 [*Annandale*]; Phagu (Simla District, 8,700 ft.), 3-v-07, ♂ ♀ *in cop.* [*Annandale*]; Kufri (8,000 ft., Simla District), 11-v-09 [*Annandale*]; Darjiling (5,000 ft.), 26-ix—1-x-08 [*Brunetti*]; (7,000 ft.), 7-viii-09, common; Kurseong, 4-vii-08 [*Annandale*]; Mussoorie, 20—24-v-05 [*Brunetti*]; Kichha (plains of Naini Tal District), 4-iv-09; Pashoke (2,200 ft), 5-ix-09, and Gangtok (6,100 ft.), 9-ix-09 (both Sikhim); Shillong; Siliguri (base of Darjiling Hills), 18—20-vii-07. Manipur (Assam, 6,400 ft.), vii-08, two pairs *in cop.* [*Pettigrew*].

I have not seen any specimen from the plains, except the single one from Siliguri and one from Kichha, which places, it will be noted, are at the foot of the hills.

NEMOPODA, R. Desv.

Of this genus I have not seen a specimen from the Orient. A species has been described by Bigot (*retronotata*, Ann. Soc. Ent. Fr., 1886, p. 391) from Celebes, but there is no certainty of it belonging to *Nemopoda*, although van der Wulp's Catalogue has it under that genus. Three "species" of *Nemopoda* by Bigot figure in the Indian Museum collection all as *nomina nuda*. These are "*N. fusciventris*" which is certainly *S. indica*, W.; "*N. formiciodes*" which is *S. viduata*, Thoms.; and "*pallipes*," which is too damaged to recognise. The last being a female, its real genus cannot be ascertained.

PIOPHILA, Fln.

A ♀ specimen taken by Dr. Annandale at Calcutta, 15-vii-08, and another at Kurseong, 9-vii-08, agree perfectly with Herr Meijere's redescription of *P. ruficornis*, v. Wulp.

A second specimen also in the Indian Museum is a ♂ and differs from *ruficornis* by the whole face and under side of the head being yellow; moreover the front tarsi are not dilated. The scutellum bears four spines as in typical *ruficornis* but the bristles on the thorax are too damaged to describe with certainty. I have named it as a var. (*flavifacies*) of *ruficornis*, and am not sure that it is not a distinct species. Taken in Calcutta, 17-iv-07.

Van der Wulp's measurement was 2 mm., my variety is 2½, the Calcutta specimen above mentioned, 3¼.

Saltella setigera, mihi, sp. nov.

(Plate xiii, fig. 19.)

♂. South India. Long. 4½ mm.

Head.—Frons, vertex and antennæ orange-red; frons with two broad, darker oval brownish marks in the shape of a V. Ocelli triangle blackish, with two small proclinate bristles. A small bristle on each side; in the middle of the frons close to the eye margin. Lower part of head, and proboscis yellowish; latter with some stiff hairs; mouth border with a row of stiff hairs on each side.

Thorax tawny orange. Dorsum with a broad black stripe occupying one-third of the entire width. The dorsum is covered rather freely with small black spines, which form four rows on the part occupied by the black stripe, and form a rather broad irregular oval around the black part. There are also numerous similar short spines on the humeral region; two large ones each side in front of the wing, and a pair of large strong dorsocentral ones, near the posterior border; also two strong ones on the posterior corner of the dorsum, on the edges. Many small ones are intermixed with the general plan of distribution.

Scutellum bright (but not at all shining) orange-red, with a strong spine each side at the base and two apical ones, close together, directed horizontally backwards.

Abdomen flat, normal; shining orange-yellow; major part of dorsum except at base and tip, black, shining, nearly bare. Numerous small hairs on each side of the basal segment, which appears somewhat long, a fan-shaped row towards the side near the posterior border, and a few very small ones scattered over the dorsum and sides of the whole abdomen. A fairly stiff bristle at the extreme edge, on each side of the second, third and fourth segments, and two diverging ones at the abdomen tip. Genital apparatus large, yellow, softly hairy, curved under tip of abdomen, with small black spines at its tip.

Legs orange-yellow, wholly covered, moderately thickly, with short black bristly hairs; tibiæ slightly darker; metatarsi yellowish white; rest of tarsi black; onychia brownish grey with a white fringe. Coxæ bare, except for two strong bristles and several very small ones all near the tip. Fore femora thickened on basal two-thirds, with six strong spines on upper side, six shorter strong ones below, in the centre, placed a little towards the inner side. On the outer side of this row is another row of eight or nine somewhat smaller ones and on the inner side of the femur is a single one, just above the centre lower row. On the fore tibiæ is a long row (extending from just beyond the base to the extreme tip) of strong very short spines, about twenty in number. On the middle femora, a long row on the front and lower side; on the middle tibiæ, a row of smaller ones on the outer, and a row of strong ones on the hinder side, a shorter row of strong ones on the inner side; also a circlet of strong but not long ones at tip. On the

hind femora a row of long ones on upper side, placed on the distal two-thirds, and a row of about six on the lower side near the tip. On the hind tibiæ there are no strong ones, but the bristly hair is arranged in several longitudinal rows. Metatarsi with long, rather soft, pale yellow hair below, posterior pairs with two rows of black spines below. In addition, the whole of the metatarsi have irregular, small stiff black hairs.

Wings very pale yellowish grey. Two short rows of minute black spines at the base. Veins yellow ; halteres orange-yellow.

Described from a single perfect ♂ in the Indian Museum collection taken by Dr. Annandale, 14-xi-08, at Nedumangad, near Trivandrum, Travancore State, South India.

Saltella metatarsalis, mihi, sp. nov.

♀. Bengal. Long. 3¼ mm.

Head.—Top of head dark shining brownish red, more or less blackish in parts. Face, mouth and lower part of head yellowish, a little more brownish behind. Ocelli flat on the surface, with two diverging hairs between them. Antennæ yellow, microscopically pubescent; arista, basal half yellow, thickened, remainder forming a black bristle; second joint of antennæ with a short bristle. Proboscis yellow, pubescent; oral orifice with two stiff, short, curved bristles each side, with a row of several hairs below them.

Thorax mainly reddish yellow; dorsum, except extreme edges, wholly dull black, with some very short bristles, apparently irregularly placed. Humeral regions with several short black bristles, followed by a row of four strong ones from the shoulder to beyond the base of the wings—all these placed just below the dorsum. Two bristles near posterior corners. Apparently only one pair of strong dorso-central bristles, possibly a smaller front pair (thorax in both specimens slightly damaged). Scutellum conspicuously orange-red, two basal bristles placed near the edge, and two apical ones close together directed horizontally backwards.

Abdomen flat, normal, practically bare, shining black, except tip, which is whitish on under side.

Legs.—Fore coxæ yellowish ; posterior coxæ brownish, base of femora brownish yellow. Remainder of legs black, except all the metatarsi which are pale yellowish white. All the legs rather closely beset with black hairs and short bristles; in addition to which there is a row of stronger bristles on the upper and lower sides of the fore femora, the lower side of the middle femora, and a double row of short bristles below the hind tarsi. The posterior tibiæ are rather thickened towards the ends and bear in that part a few stronger bristles.

Wings clear ; veins and halteres yellow.

Described from two examples in the Indian Museum collection, taken at Tinpahar (near Rajmahal, Bengal), 7-vii-09, by Dr. Annandale.

REVISED LIST OF THE ORIENTAL SPECIES OF **SEPSIS**.

A. *Wing with a spot at the tip.*

cynipsea, L., 1761. F. Suec.
Loc.—Himalayas, Nepal.
modesta, Meij., 1906. Ann. Mus. Hung., iv, 172, ♂ ♀.
Loc.—Ceylon; Western India.
himalayensis, mihi, sp. nov., ♂ ♀; **plate xiii**, figs. 1, 2.
Loc.—Darjiling.
similis, mihi, sp. nov, ♂.
Loc.—Darjiling.
rufibasis, mihi, sp. nov., ♂.
var. *major*, mihi, ♂.
var. *obscuripes*, mihi, ♂.
Loc.—Darjiling (typical form and both varieties).
fulvolateralis, mihi, sp. nov., ♂.
Loc.—Himalayas.
violacea, Meig.
Loc.—Shanghai.
apicalis, Meij., 1906. Ann. Mus. Hung., iv, 168, ♂ ♀, pl. ii, 1, fore leg ♂.
Loc.—Papua (Astrolabe Bay, Paumomu-Fluss, Moroka).
limbata, Meij., 1906. Ann. Mus. Hung., iv, 169, ♂ ♀, pl. ii, 2, fore leg ♂.
Loc.—Papua (Paumomu-Fluss, Moroka).
basifera, Wlk., 1859. Pr. Linn. So. Lond., iii, 124, ♂ ♀.
Meij., Ann. Mus. Hung., iv, 170, ♂, pl. ii, 3 (wing), 4 (middle metatarsus), ♂.
Loc.—Amboina, Aru Islands, Papua (Paumomu-Fluss).
flava, mihi, sp. nov., ♂; **pl. xiii**, 4 (fore leg, ♂), 5 (hind leg, ♂).
Loc.—India (Bengal, Orissa).
rufipectus, mihi, sp. nov., ♂.
Loc.—West Bengal.
tincta, mihi, sp. nov., ♂ ♀; **pl. xiii**, 6 (fore leg, ♂), 7 (tip of ♂ abdomen).
Loc.—India, Himalayas, Bengal, Orissa, South India.
lineatipes, mihi, sp. nov., ♂.
Loc.—Darjiling.
dissimilis, mihi, sp. nov., ♂ ♀; **pl. xiii**, 8 (fore leg, ♂).
Loc.—South India (Quilon).
dilata, mihi, sp. nov. (? ♂).
Loc.—Bengal.
fascipes, Wlk., 1860. Pr. Linn. So. Lond., iv, 163, ♀.
Loc.—Macassar.
linearis, Wlk., 1849. List. Dipt. Brit. Mus., iv, 998, ♂.
Loc.—Philippines.
monostigma, Thoms., 1868. Eugene Resa, Dipt., 587, ♂.
Loc.—China.

B. *Wing entirely clear.*

indica, Wied., 1830. Auss. Zweifl., ii, 467; **pl. xiii,** 9—12 (thorax vars.), 13 (fore leg, ♂).
Loc.—India; Calcutta, Bengal, South India, Assam.

trivittata, Big., 1886. Ann. So. Ent. Fr., 388.
Loc.—Bengal, South India, Assam, Rangoon.

rufa, Macq., 1850. Dipt. Exot. Supp., iv, 269, ♀.
Meij., Ann. Mus. Hung., iv, 179, ♂ ♀, and notes.
Loc.—Nepal, Assam, Himalayas, Bengal, Orissa, Bombay, Rangoon, Papua. Also Egypt, from whence originally described.

spectabilis, Meij., 1906. Ann. Mus. Hung., iv, 179, ♂ ♀, pl. ii, 10 (fore leg, ♂).
Loc.—Singapore, Papua (Stephansort), South India.

brevicosta, mihi, sp. nov., ♂ ♀.
Loc.—Bengal, Punjab, South India.

adjuncta, mihi, sp. nov., ♂; **pl. xiii,** 14 (fore leg, ♂).
Loc.—South India.

brevis, mihi, sp. nov., ♂; **pl. xiii,** 15 (fore leg, ♂).
Loc.—Central India.

tenella, Meij., 1906. Ann. Mus. Hung., iv, 183, ♂ et (?) ♀, pl. ii, 12 (fore leg, ♂).
Loc.—Singapore, Sylhet, Chittagong, base of Darjiling Hills (Sukna, 500 ft.), Bengal, South India.

coprophila, Meij., 1906. Ann. Mus. Hung., iv, 178, ♂ ♀, pl. ii, 10 (fore leg, ♂).
Loc.—Singapore, Papua (Stephansort), South India, Calcutta, Bengal, Ceylon, Rangoon.

humeralis, *mihi, sp. nov.,* ♂.
Loc.—Simla, ? Shanghai.

nepalensis, mihi, sp. nov., ♀.
Loc.—Nepal.

bicolor, Wied., 1830. Auss. Zweifl., ii, 468.
javanica, Meij., 1904. Bijd. Dierk., xviii, 107, pl. viii, 18 (fore leg, ♂).
id., Meij., 1906. Ann. Mus. Hung., iv, 184, ♂ ♀, pl. ii, 13 (fore leg, ♂).
Loc.—Java, Papua, Rangoon, Colombo, South India, Bengal, Darjiling, Sylhet, Nepal, Naini Tal. Also China, from whence originally described.

N.B.—Herr Meijere's two diagrams of the fore leg do not agree. Specimens identified by me agree with his second figure.

decipiens, Meij., 1906. Ann. Mus. Hung., iv, 177, ♂, pl. ii, 9 (fore leg, ♂).
Loc.—Papua (Stephansort).

beckeri, Meij., 1906. Loc. cit., 185, ♂ ♀, pl. ii, 14 (fore leg, ♂).
Loc.—Bombay, Singapore.

pubipes, mihi, sp. nov., ♂; **pl. xiii,** 16 : 17, 18 (fore, middle, hind legs, ♂).
Loc.—Nepal.

fasciculata, mihi, sp. nov., ♂.
Loc.—Ceylon, Calcutta.

viduata, Thoms., 1868. Eugene Resa, 587.
Loc.—China, Assam, Eastern Himalayas, Bengal, Calcutta, South India, Rangoon, Batavia, Manila.

N.B.—In addition to the above, all of which appear to be distinct species, the following have been described, the descriptions being too brief or too weak for identification.

S. **nitens,** Wied., 1824. Analec. Ent., 57, and (1830) Auss Zweifl., ii, 467.
Loc.—China.

N.B.—This is, according to Handlirsch (who kindly compared a specimen with the type), quite distinct from both typical *bicolor,* Wied. (*javanica,* Meij.), and the red variety of *bicolor,* with which I had thought it might have been identical.

S. **lateralis,** Wied., 1830. Auss. Zweifl., ii, 468.
Loc.—China.

N.B.—A specimen in indifferent condition in the Indian Museum collection, incorrectly determined by Bigot as this species, is my *brevicosta.* An example of my *brevicosta,* sent to the Vienna Museum, and kindly compared by Herr Handlirsch with Wiedemann's type, was returned as certainly distinct from that author's species.

S. **complicata,** Wied., 1830. Auss. Zweifl., ii, 468.
Loc.—China.

S. **testacea,** Wlk., 1860. Pr. Linn. So. Lond., iv, 163, ♂ ♀.
Loc.—Macassar.

S. **frontalis,** Wlk., 1860. Loc. cit., iv, 163, ♂ ♀.
Loc.—Macassar.

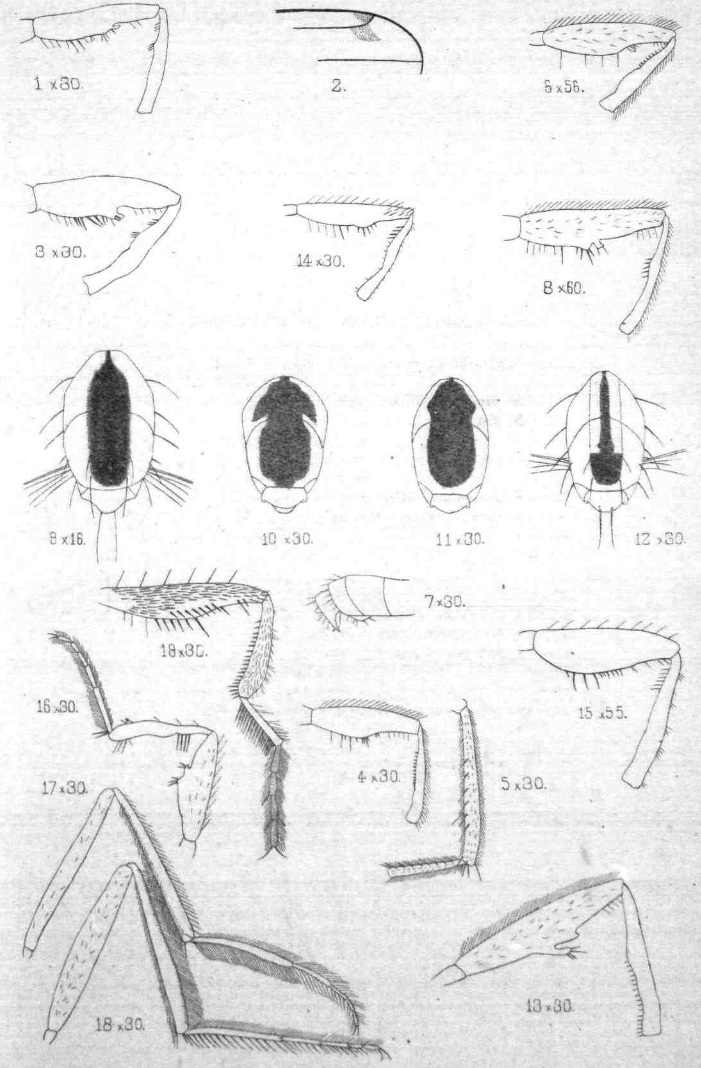
N.B.—In this species Walker describes the ♂ as black, and the ♀ as with a yellow thorax and black abdomen. This is the only instance to my knowledge in which the sexes differ in colour, with the exception of my new species *dissimilis,* in which, however, the colours are reversed.

S. **revocans,** Wlk., 1860. Loc. cit., iv, 163, ♀.
Loc.—Macassar, Philippines.

N.B.—As in none of these six descriptions is any mention made of a wing spot, the presumption is that they will all fall in the "wing clear" division of the genus.

EXPLANATION OF PLATE XIII.

FIG. 1.—*Sepsis himalayensis*, Brunetti, fore leg, ♂.
,, 2.— ,, ,, wing spot.
,, 3.—*S. punctum*, Fab., fore leg, ♂.
,, 4.—*S. flava*, Brunetti, fore leg, ♂.
,, 5.— ,, ,, hind leg, ♂.
,, 6.—*S. tincta*, Brunetti, fore leg, ♂.
,, 7.— ,, ,, tip of ♂ abdomen.
,, 8.—*S. dissimilis*, Brunetti, fore leg, ♂.
,, 9.—*S. indica*, Wied., thorax.
,, 10.— ,, ,, ,,
,, 11.— ,, ,, ,,
,, 12.— ,, ,, ,,
,, 13.— ,, ,, fore leg, ♂.
,, 14.—*S. adjuncta*, Brunetti, fore leg, ♂.
,, 15.—*S. brevis*, Brunetti, fore leg, ♂.
,, 16.—*S. pubipes*, Brunetti, fore leg, ♂.
,, 17.— ,, ,, middle leg, ♂.
,, 18.— ,, ,, hind leg, ♂.
,, 19.—*Saltella setigera*, Brunetti, fore leg, ♂.


1 x30.
2.
6 x56.
3 x30.
14 x30.
8 x60.
9 x16.
10 x30.
11 x30.
12 x30.
19 x30.
7 x30.
16 x30.
15 x55.
17 x30.
4 x30.
5 x30.
18 x30.
13 x30.

XXVIII. A NEW SPECIES OF *FREDERICELLA* FROM INDIAN LAKES.

By N. ANNANDALE, *D.Sc.*, *Superintendent*, *Indian Museum*.

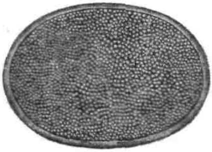
Fredericella indica, sp. nov.

Zoarium delicate, branching sparsely, recumbent or with upright (or rather dependent), lax branches consisting of two or three zoœcia only.

Zoœcia very slender, distinctly but slightly emarginate at the tip, with a strong furrowed keel running along the dorsal surface from the emargination; the external surface minutely roughened, sometimes with small sand grains adherent to it, practically colourless but imperfectly transparent.

Lophophore bearing about twenty tentacles, which are of moderate length and very slender; the web at their base very narrow.

Alimentary canal elongated and slender, practically colourless.



Statoblast of *Fredericella indica* (upper surface). × 120.

Statoblast variable in shape and size but as a rule broadly oval, sometimes kidney-shaped, surrounded by a stout chitinous ring and smooth on the surface of the lower valve; the upper valve covered with minute prominences the base of which is somewhat star-shaped and the apex rounded. The prominences sometimes cover the whole surface almost uniformly but are sometimes sparser in the middle than towards the edges.

Habitat.—Western India; under stones in Igatpuri lake, Western Ghats, Bombay Presidency, and on lower surface of leaves of water-plants in Shasthancottah lake, Travancore; at both places taken by myself in November.

The most definite character in which this species differs from *F. sultana* is the ornamentation of the statoblast, but there also appear to be differences in the structure of the zoœcium and the lophophore. From *F. tanganyikæ*, of which the statoblasts are

unknown, it differs in having emarginate zoœcia with a well-defined furrowed keel and in not being thickly encrusted with comparatively large sand grains.

At Shasthancottah the zoarium was found entangled with that of a delicate form of *Plumatella fruticosa* which closely resembled it externally. With a little care, however, it was found possible to disentangle the two species. The point is important as tending to explain Jullien's[1] belief that *Fredericella* is merely an abnormal form of *Plumatella*, and in this connection I may state that in Scotland I have found a statoblast of *Plumatella* adhering to and partially embedded in the ectocyst of *Fredericella*.

Fredericella has not hitherto been recorded from the Oriental Region, although *F. sultana* is said to occur in Australia as well as in Europe and North America.

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[1] *Bull. Soc. Zool. France*, vol. x, p. 121 (1893).

XXIX. DIAGNOSES OF NEW SPECIES AND VARIETIES OF FRESHWATER CRABS.

By A. Alcock, *F.R.S.*

No. 4.

Genus **Paratelphusa,** Edw.

(Type: *P. tridentata*, Edw.)

Subgenus **Paratelphusa.**

Paratelphusa (Paratelphusa) trilobata, sp. nov.

Differs from *P. spinigera* only in the following particulars:—

The carapace is flatter, and the "cervical groove" is broader: its antero-lateral border on either side is produced between the external-orbital and lateral-epibranchial spines into a broad and very prominent, laminar lobe.

The subterminal spine on the upper border of the arm is blunt and coarse.

From Sibsagar, Assam: a single adult female.

Paratelphusa (Paratelphusa) blanfordi, sp. nov.

This is an aberrant member of the subgenus, having no spines or lobes between the external-orbital and lateral-epibranchial tooth, and no spine on the upper border of the arm. It is, however, closely related to *P. spinigera*.

It has much the appearance of *P. spinigera* except that its carapace is flatter; but is distinguished from that and every other Indian species but one in the form of the fingers, which have broad, blunt, "spooned" tips.

It has nothing to do with *Paratelphusa spinescens*, Calman, which has spiny antero-lateral borders and is not a *Paratelphusa* at all since it has the simple mandibular palp of *Potamon*.

From various places in Baluchistan: 10 males, 10 females.

Paratelphusa (Paratelphusa) grayi, sp. nov.

This is very close indeed to *P. sinensis*, from which it differs only in the following particulars:—

The "cervical groove" is distinct, and in places is almost deep: the front shows no trace of division into two lobes: the teeth

of the antero-lateral borders are not so sharp. The merus of the external maxillipeds is longer.

The abdomen of the adult male is even more decidedly hour-glass-shaped than in *P. sinensis*, the fifth segment being a long tapering joint, and the long sixth segment being narrower at its proximal end than in *P. sinensis*.

From Moung Sal, Makhok River: 13 males, 15 females.

Subgenus **Barytelphusa.**

(Type: *Paratelphusa jacquemontii* (Rathbun) = "*Telphusa indica*" of many authors.)

Paratelphusa (Barytelphusa) lamellifrons, sp. nov.

Very closely related to "*Telphusa indica*," from which it may be recognised by the following characters:—

The carapace is longer, and the ends of the wings of the "cervical groove" are broad, superficial and vague.

The front is a very prominent, hardly-deflexed lamella.

The distance between the tip of the external orbital tooth and the base of the epibranchial spine forms half the antero-lateral border of the carapace.

The epigastric portion of the continuous post-orbital crest is as thin as the true post-orbital portion; the outer end of the crest forms a prominent, but undetached, lobe, and the edge of the whole crest is elegantly crenulate.

From Travancore: 1 adult female, 1 young female.

Paratelphusa (Barytelphusa) edentula, Alcock.

I have already mentioned this species as a variety of "*Potamon lugubre*." At that time, although I knew that the terminal joint of the mandibular palp was bifurcate in "*Potamon lugubre*" (= *Telphusa lugubris*, Wood-Mason), I did not realize that the mandible was going to be so destructive to the established nomenclature, and that *Telphusa lugubris*, Wood-Mason, belongs to the present subgenus of *Paratelphusa*.

Paratelphusa (Barytelphusa) napæa, Alcock.

This has also been mentioned as a species of *Potamon* allied to "*Potamon lugubre*" (Wood-Mason). It is very closely related to *Paratelphusa (Barytelphusa) lugubre* (Wood-Mason).

Paratelphusa (Barytelphusa) pulvinata, sp. nov.

This species is distinguished from everything in the subgenus (1) by the carapace, which is subcylindrical, with the cervical groove running in a long and comparatively narrow loop, as in *Gecarcinucus*, and (2) by the long, narrow, sixth abdominal segment of the adult

male—the greatest breadth of this segment is barely two-thirds of its length.

From Coorg and from Ootacamund: 6 males, 2 females.

Paratelphusa (*Barytelphusa*) *pollicaris*, sp. nov.

Although this species comes from South India its closest relative is the Eastern Himalayan *P. lugubris* (Wood-Mason). As in the type of that species the carapace is flattish and about half of its antero-lateral borders lie in front of the lateral epibranchial spine.

The cervical groove is very deep and broad, and runs wide, to a point behind the much-retreated lateral epibranchial denticle.

The epigastric and post-orbital crests form one strong, nearly straight ridge, which runs, on either side, from the mesogastric furrow obliquely into the lateral epibranchial denticle.

The fingers are peculiarly broad, particularly the fixed finger.

From South India, probably Travancore: 3 males and 3 females, adult, and 6 non-adults of small size.

Subgenus **Phricotelphusa** (Type: *Telphusa callianira*, de Man).

Paratelphusa (*Phricotelphusa*) *campestris*, sp. nov.

Singular to tell, this species, from Batnagore near Calcutta, is so closely related to *P. gageii* from an elevation of about 5,000 feet in the Eastern Himalayas that, having only a single (male) individual to examine, I almost hesitate to separate it.

It resembles a *P. gageii* that has been holy-stoned, the epigastric crests being, not distinct elevations, but mere eroded patches; the post-orbital crests being low, blunt, and faint; and the lateral epibranchial tooth being entirely absent.

The carapace is more convex, and the antero-lateral borders are blunt and ill defined. The colour is greenish yellow. In the single specimen—an adult male with a carapace $\frac{5}{8}$ths of an inch long and $\frac{7}{8}$ths broad—the exopodite of the external maxillipeds has no trace of a flagellum.

Subgenus **Liotelphusa** (Type: *Telphusa levis*, Wood-Mason).

Paratelphusa (*Liotelphusa*) *levis* (Wood-Mason) var. *quadrata*.

Wood-Mason did not separate this variety, but to me it seems worthy of recognition.

The carapace is almost square, and its length is seven-eighths its greatest breadth. The "cervical groove" is hard to make out in any part of its course. The outer orbital angle and the lateral epibranchial tooth are more prominent than in the type of *P. levis*. The antero-lateral borders of the carapace, under a lens, are subcristiform. The epigastric crests, such as they are, are not so plainly continuous with the post-orbital crests, and the latter are almost sharp in their outer half.

From the Naga and Khasi Hills and from Assam: 19 males, 25 females.

Paratelphusa (Liotelphusa) austrina, sp. nov.

This species from South India is close to *P. levis*, but is easily distinguished by the form of the front and of the male abdomen.

The free edge of the front proper is quite distinct and separate from the antennular edge of the front, as it is in *P. hydrodromus* (Herbst).

The three terminal segments of the male abdomen are much contracted; the sixth segment is narrow and has parallel sides, and its length exceeds its maximum breadth.

Subgenus **Globitelphusa** (Type: *Paratelphusa bakeri*).

Paratelphusa (Globitelphusa) bakeri, sp. nov.

Carapace broad, subcylindrical, with the regions barely distinguishable, the cervical groove being distinct only where it bounds the mesogastric area posteriorly.

Front broad, square-cut, almost vertically deflexed.

External orbital angle and lateral epibranchial denticle insignificant.

Epigastric crests just recognizable, post-orbital crests more distinct but still not conspicuous.

Length of 6th abdominal segment just equal to its distal breadth: 7th segment very much longer than broad.

Mandibular palp as in *P. tridentata*, Edw. Exopodite of external maxillipeds pointed, hairy, non-flagellate. Exopodite of 1st and 2nd maxillipeds with a vestigial flagellum.

Chelipeds unequal. Legs rather slender.

Chiefly from Ganjam in North Cachar: 10 males, 8 females.

Paratelphusa (Globitelphusa) bakeri var. *cylindrus*.

The cylindrical or barrel-like carapace has the branchial regions independently inflated in this variety. The epigastric crests are more distinct, and the post-orbital crests are less distinct, than in the type.

From the Naga Hills and from Assam: 9 males, 1 female.

Paratelphusa (Globitelphusa) pistorica, sp. nov.

P. pistorica is like *P. bakeri* var. *cylindrus* in form. It differs in having the side walls of the carapace rugose, and in having the exopodites of the 1st and 2nd maxillipeds flagellate: there may be a papillary vestige of a flagellum on those of the external maxillipeds.

From Assam and Cachar: 8 males, 7 females.

The three following species have a squarish and flattish carapace quite unlike the broad cylindrical carapace of the three previous species; but as the epigastric and post-orbital crests and the lateral epibranchial spine are all insignificant, and the cervical groove is indistinct, and the exopodite of the external maxillipeds is

non-flagellate, I include them in the subgenus *Globitelphusa*: all three are very small species and come from Mahableshwar.

Paratelphusa (*Globitelphusa*) *gubernatoris*, sp. nov.

Carapace flat, square; "cervical groove" reduced to a fine crescent bounding the mesogastric area posteriorly.

Front broad, square, strongly deflexed. Epigastric crests just distinguishable: post-orbital crests distinct only at their outer end.

Three terminal segments of male abdomen much contracted: in the 6th segment the distal breadth slightly exceeds the proximal breadth and equals the length.

Mandibular palp as in *P. tridentata*, Edw. Chelipeds unequal: tips of fingers pointed. Legs long, none of the joints particularly hirsute.

From Mahableshwar: 35 males, 22 females.

Paratelphusa (*Globitelphusa*) *pilosipes*, sp. nov.

Very like *P. gubernatoris*, but the epigastric and post-orbital crests can be imagined rather than discerned, and the lateral epibranchial tooth may be altogether absent: The antennal flagellum is vestigial. The finger-tips are broad, blunt, and spooned. The dactyli of the legs are short and clumsy and are thickly clothed with tufts of bristles.

From Mahableshwar: 5 males.

The question naturally arises: is this a second form of the male of *P. gubernatoris*?

Paratelphusa (*Globitelphusa*) *fronto*, sp. nov.

Much like *P. gubernatoris* and *pilosipes*, but the carapace is convex. Front of the adult immensely broad, half the maximum breadth of the carapace. Lateral epibranchial tooth distinct, very near the angle of the orbit. Epigastric and post-orbital crests very indistinct. Fifth segment of male abdomen very narrow, its length equal to its distal breadth: sixth segment also very narrow, its length considerably exceeds its distal breadth which is greater than its proximal breadth: seventh segment much longer than broad. Antennal flagellum much impacted and contracted: antennal flagellum absent. Chelipeds unequal: fingers pointed. Legs studded all over with tufts of long, coarse bristles.

From Mahableshwar: 23 males, 6 females.

Genus **Gecarcinucus**, Edw.

In this genus the front is a long, narrow, greatly deflexed lobe, hardly wider than the orbit: the dactyli of the crawling legs are slender. In other respects it agrees with *Paratelphusa*; and it is doubtful whether the two genera are really distinct.

Subgenus **Gecarcinucus** (Type : *G. jacquemontii*, Edw.).

In this subgenus the lower outer corner of the orbit forms a gutter-like recess and there is no trace of a lateral epibranchial denticle.

Gecarcinucus (Gecarcinucus) edwardsi, Wood-Mason, sp. nov.

Differs from *G. jacquemontii* in that the sides of the front are convergent, and the finger-cleft and the neighbouring part of the inner surface of the palm are covered with a thick, shaggy mat of hair.

From Khandalla: one male.

Subgenus **Cylindrotelphusa** (Type : *Gecarcinucus steniops*).

Carapace and front as in *Gecarcinucus*, but the orbit is of the usual form and there is a small lateral epibranchial denticle.

Gecarcinucus (Cylindrotelphusa) steniops (Wood-Mason), sp. nov.

"*Telphusa steniops*," Wood-Mason (MS. name only).

Carapace subcylindrical : "cervical groove" forming a long narrow loop, the trend of which is fore-and-aft ; very broad and deep and dividing the carapace into tumid lobe-like regions. Front a long, narrow, square-cut, strongly-deflexed lobe, hardly wider than the orbit. Antero-lateral borders of carapace full, blunt, coarsely crenate : a small lateral epibranchial tooth, placed close to the orbit. Epigastric crests broad and low : post-orbital crests low, blunt, indistinct, crenulate or broken in their outer half. In the sixth segment of male abdomen the length equals or slightly exceeds the distal breadth : seventh segment a good deal longer than broad.

Efferent branchial openings subtubular and exposed, as in *Gecarcinucus* (and in some species of *Paratelphusa*). Mandibular palp as in *Paratelphusa tridentata*, Edw. Exopodites of all the maxillipeds with a strong flagellum.

From Travancore : 14 males, 11 females.

With reference to my last paper in this series, I find that a subgeneric name *Oziotelphusa* was given by P. Müller to "*Telphusa*" *hippocastanum*, Müll. = "*Potamon*" *hydrodromus* (Herbst). This name *Oziotelphusa* must therefore be adopted for the subgenus *Leschenaultia*, though I may explain that in using the name *Oziotelphusa* it is the bare name, and nothing but the bare name, that I accept. *Paratelphusa (Leschenaultia) hydrodromus* and *bouvieri* will, therefore, now stand as *Paratelphusa (Oziotelphusa) hydrodromus* and *bouvieri*.

Again, I find that "*Paratelphusa*" *nilotica*, Edw., is not a true *Paratelphusa* of the *Paratelphusa tridentata*, type ; but has a simple mandibular palp like those species (*dayanum*, *wood-masoni* (= *edwardsi*), *crenuliferum*, and *mariensis*) which I have here separated as a subgenus of *Potamon* under the name of *Paratelphusula*.

But, for reasons quite distinct from mine, Ortmann long ago made "*Paratelphusa*" *nilotica* the type of a subgenus of *Potamon* which he named *Acanthotelphusa.* This name, therefore, must be substituted for *Paratelphusula*; and I am very glad of it, for "*Paratelphusula*" is too much like "*Paratelphusa*," and the "Telphusidæ" are confusing enough already. *Potamon* (*Paratelphusula*) *dayanum*, *wood-masoni* (= *edwardsi* No. 2), *fungosum*, *feæ*, *calvum*, *crenuliferum*, and *martensi*, will therefore now stand as *Potamon* (*Acanthotelphusa*) *dayanum*, *wood-masoni*, *fungosum*, *feæ*, *calvum*, *crenuliferum*, and *martensi*.

XXX. ON SOME NEW OR LITTLE-KNOWN MYGALOMORPH SPIDERS FROM THE ORIENTAL REGION AND AUSTRALASIA.

By STANLEY HIRST.

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The following note contains the descriptions of a new genus and six new species of mygalomorph spiders, and also notes on some incompletely known species. The forms dealt with are nearly all from the Oriental region and are preserved in the collections of the British Museum (Nat. Hist.) or of the Indian Museum (Calcutta). The new genus diffe s from all other Oriental mygalomorph spiders in having a sound-producing organ between the mandibles.

Damarchus assamensis, sp. nov.

Colour a more yellowish brown than *D. oatesii*, Thorell.

Carapace considerably shorter than patella and tibia of first or fourth legs or than metatarsus of fourth. Anterior row of eyes more strongly procurved than in *D. oatesii*.

Palp. Spine of palpal organ longer, as compared with the bulb, than is the case in *D. oatesii* (plate xxiv, fig. 8).

Legs. Patella and tibia of first leg a little shorter than those of the fourth; metatarsus of first armed below towards the posterior side with 1.1 spines and with a pair of apical spines; its anterior surface unarmed. Metatarsus of the second leg armed in the same way as that of the first, but an additional anterior spine is present below and an antero-dorsal spine also. Tibia of first leg with its armature resembling that of the metatarsus of the second but with 1.1 upper anterior spines; the large inner apical spine with its curvature less pronounced than that of *D. oatesii* (fig. 7).

Tibia of second leg lacking the inner ventral spine. Tibiæ and metatarsi of posterior legs armed below with a number of spines. Patella of third leg with two or three anterior spines. Tarsi of all four pairs of legs scopulate, the metatarsi of the anterior legs also scopulate apically.

Measurements in mm. Total length 14, length of carapace 7·25, of first leg 24, of second leg 22·5, of third leg 21, of fourth leg 28.

Material. A single adult male from Sibsagar, Assam, collected by Mr. Peal. (Indian Museum collection.) A number of females

were found in the same bottle, but they do not differ in structure from the female of *D. oatesii.*

Genus SELENOCOSMIA.

In 1897 Mr. R. I. Pocock [1] instituted a new genus *Phlogiellus* for a Selenocosmid spider in which the claws of the fourth leg are three in number. This third claw is present, however,[2] in the great majority of the species of *Selenocosmia* and *Chilobrachys* (including the type species of these two genera) and it will be necessary therefore to abandon the genus *Phlogiellus* and to regard it as a synonym of *Selenocosmia.* The division of the tarsal scopulæ of the legs of all four pairs is mentioned by Mr. Pocock in his description of *Phlogiellus*, and this character seems peculiar to the species for which the genus was founded. It must be remembered, however, that the structure of the tarsal scopulæ varies considerably both in *Selenocosmia* and *Chilobrachys* and can not be regarded as a satisfactory generic character. In most of the species belonging to these two genera the tarsi of the fourth legs alone are divided, but in *S. stirlingi*, Hogg, the fourth tarsus is entire or very indistinctly divided. Whilst in *S. insulana*, sp. nov., *S. sarawakensis*, *C. sericeus*, Thorell, and *C. subarmatus*, Thorell, the tarsal scopulæ of both the posterior pairs are divided.

Selenocosmia honesta, sp. nov.

♂. *Colour.* Cephalothorax buff-coloured, appendages russet, the abdomen ochraceous.

Carapace shorter than patella and tibia of first or fourth legs and almost equalling metatarsus of fourth in length. Anterior row of eyes procurved; anterior medians a little closer to one another than to the anterior laterals.

Mandible furnished with long and fine bristles on its outer surface.

Palp. Numerous long, fine hairs, which are not set so close together as in a typical *Chilobrachys* are present above the stridulatory bacilli. Spine of palpal organ long, curved and rather thick, the point blunt and slightly enlarged (fig. 4).

Legs 4, 1, 2, 3. Patella and tibia of first leg a little shorter than the metatarsus and tarsus of fourth and much longer than its patella and tibia. Metatarsi of the three anterior legs scopulate for almost their entire length. Scopula of metatarsus of fourth leg occupying

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[1] *Abhandl. d. Senckenb. naturf. Ges.*, xxiii, pp. 595—597, pl. xxv (1897).

[2] In searching for this minute unpaired claw it is necessary to remove the ungual tuft on one side and sometimes the pad supporting it also; great care must be used in doing this as the claw itself is easily destroyed. A third claw is present in the following species—*Selenocosmia fuliginea*, Thorell, *S. himalayana*, Poc., *S. inermis*, Auss., *S. javanensis*, Walck., *S. lanipes*, Auss., and in the new species described above; *Chilobrachys brevipes*, Thorell, *C. fumosus*, Poc., *C. cervinus*, Thorell, *C. fimbriatus*, Poc., *C. hardwichi*, Poc., *C. nitelinus*, Karsch, *C. sericeus*, Thorell, *C. stridulans*, Wood-Mason, *C. thorelli*, Poc., and *C.* (*Neochilobrachys*) *subarmatus*, Thorell.

more than two-thirds of the length of the segment and extending laterally almost to its base. Tarsal scopulæ of the first three legs undivided, that of the fourth divided by a line of setæ.

Measurements in mm. Total length 41, length of carapace 20, of first leg 71·5, of second 65, of third 55·5, of fourth 74, of patella and tibia of first leg 27·5, of patella and tibia of fourth 25, of metatarsus of fourth 20·5.

Material. A single male from Fak Fak, Dutch New Guinea. (Brit. Mus. coll.)

Selenocosmia insulana, sp. nov.

♂. *Colour.* Carapace covered with short yellowish hair, the chitin below very dark; appendages fawn; abdomen with long cinnamon-coloured hairs.

Carapace shorter than patella and tibia of first or fourth legs, equal to patella and tibia of second or to metatarsus and tarsus of first and slightly exceeding patella, tibia and tarsus of palp in length. Anterior median eyes further apart from one another than from the anterior laterals. Fovea small in extent.

Mandible with the outer surface furnished with very long stridulatory setæ.

Palp. Bacilli of coxa of palp very slender. Spine of palpal organ fairly long, curved and keeled, the terminal part slender (fig. 5).

Legs 1, 4, 2, 3. First and fourth legs almost equal in length. Patella and tibia of first leg equalling tibia, metatarsus and tarsus of third in length and considerably exceeding patella and tibia of fourth. Metatarsus of fourth a little longer than its tibia and equal in length to the tibia of the first. First and second pairs of legs with the tarsal scopulæ undivided and with their metatarsi scopulate except at the base. Tibia of first leg also with a scopula which is especially thickened apically. Tarsal scopulæ of the legs of the two posterior pairs divided by a line of setæ. Metatarsus of fourth with a scopula (in which long hairs are intermingled) occupying almost two-thirds of the length of the segment.

Claws of fourth leg three in number.

Measurements in mm. Total length 18; length of carapace 9, of first leg 28·5, of second leg 24, of third leg 20, of fourth leg 27·5, of patella and tibia of first leg 11·75, of patella and tibia of fourth 9·75, of metatarsus of fourth 7.

Material. A single adult male from Djampea Island (South of Salayer Island), collected by Mr. A. Everett. (Brit. Mus. coll.)

Selenocosmia obscura, sp. nov.

♂. *Colour.* Carapace pale brown, upper side of legs walnut-brown with narrow yellowish apical bands, paler below; abdomen brown, the long hairs yellowish.

Carapace much shorter than patella and tibia of first or fourth legs, slightly shorter than metatarsus of fourth and slightly longer

than patella, tibia and tarsus of palp. Front row of eyes slightly procurved, the medians a little further apart from one another than from the laterals.

Mandible. Stridulatory setæ of mandible very long and fine.

Palp. Bacilli of anterior surface of coxa of palp numerous and arranged in a number of rows. They are mostly rather fine and become finer until they shade in to the hairs above. Spine of palpal organ long, strongly curved and twisted, its basal part very wide and furnished with a strong keel which ends at the base of the spine in a projecting lobule. Basal part of spine very wide, the distal part very slender and the point not distinctly enlarged (fig. 6).

Legs 4, 1, 2, 3. Patella and tibia of first leg a little longer than the corresponding segments of the fourth and a little shorter than the metatarsus and tarsus of the fourth. Metatarsus of fourth shorter than patella and tibia of second but exceeding patella and tibia of third in length. Tarsal scopulæ of first and second legs entire, that of the third divided by a very fine line of setæ and the fourth by a distinct line of setæ. Metatarsi of first and second legs scopulate for their entire length, metatarsus of fourth distally scopulate. Fourth leg with three claws.

Measurements in mm. Total length 26·5; length of carapace 12·75, of first leg 44·75, of second leg 38·5, of third leg 33·5, of fourth leg 47·5, of patella and tibia of first leg 17·5, of patella and tibia of fourth 16, of metatarsus of fourth 13·25.

Material. A single adult male (the type) and several young females from Sarawak, collected by Mr. C. Hose. (Brit. Mus. coll.)

Remarks. This species is closely allied to *S. inermis*, Auss., chiefly differing from that species in its much larger size and in the greater length of the limbs as compared with the carapace.

Chilobrachys fumosus, Pocock.

Musagetes fumosus, Poc., *Ann. Mag. Nat. Hist.* (6), xv, p. 174, pl. x, fig. 7 (1895); *Chilobrachys fumosus*, id., *Fauna Brit. India*, p. 196 (1900).

♂. *Cephalothorax* much shorter than patella and tibia of first or fourth legs and equalling metatarsus of fourth or patella and tibia of palp in length.

Mandible with the spines on the outer side rather fine and a little longer than is usually the case in the genus *Chilobrachys*.

Palp. Bacilli of coxa of palp with a well-marked band of hairs dorsally. Palpal organ with the spine long, slender and twisted. The bulb is traversed by a keel which runs along the spine forming the inner limit of a conspicuous groove. Terminal part of spine with the edges turned down so as to enclose a groove and with the edge of the outer side forming a projecting lateral lobe just before the point; the point itself being slightly enlarged (fig. 3).

Legs 4, 1, 2, 3. Patella and tibia of first and fourth legs almost equal in length. Metatarsi of anterior legs scopulate throughout their length, metatarsus of the fourth leg scopulate for more than a

third of its length, the scopula being divided by a line of bristles. Tarsi of legs of fourth pair alone divided and ending in three claws.

Measurements in mm. Length of cephalothorax 14·25, its width 12; length of first leg 47, of second 42, of third 39, of fourth 52, of patella and tibia of first 18, of patella and tibia of fourth 17·5.

Material. A male from Kurseong, Eastern Himalayas (Dr. N. Annandale). A male and four females from Sureil, Darjiling (Col. A. Alcock). A female specimen from Burroi, at the foot of the Dafla Hills.

Remarks. The type is a female specimen labelled "North India." The specimens which I have identified as belonging to this species differ from the typical specimen in having the spines on the outer surface of the mandible more numerous and not so clearly arranged in rows.

Chilobrachys assamensis, sp. nov.

♂. *Colour.* Carapace yellowish; body and legs russet-brown, lower surface of body a little paler.

Carapace much shorter than patella and tibia of first or fourth leg, longer than patella and tibia of palp and equal to metatarsus of fourth. Eyes of anterior row slightly procurved and subequal in size, the anterior medians further apart from one another than the anterior laterals. Fovea wide and only slightly procurved.

Mandible. Outer surface of mandible furnished with slender setæ which are not very long and are either arranged in definite rows or irregular in disposition.

Palp. A narrow fringe of setose hairs with a metallic sheen, overhangs the bacilli. Spine of palpal organ short and with a spiral twist; the basal part broad, the narrowed apical portion short and blunt. A sharp keel traverses the bulb and runs along the spine, forming the outer limit of a deep groove, which is limited on the inner side by a second keel. A second slight groove makes its appearance towards the apex of the spine running parallel with the main groove, on its outer side (fig. 1).

Legs 4, 1, 2, 3. Patella and tibia of first leg equal in length to or slightly longer than the patella and tibia of the fourth. Patella and tibia of third leg and palp equal in length. Metatarsi of first and second legs scopulate for almost their entire length; the scopula of the fourth metatarsus occupying about a third of the length of the segment, and divided by a line of setæ. Tarsal scopulæ of the three anterior pairs of legs undivided, that of the fourth being divided by a fine line of setæ. Claws of the fourth leg three in number.

Measurements in mm. Total length 25, length of carapace 10·5, of first leg 33·5, of second leg 29·5, of third 27, of fourth 36·75, of patella and tibia of palp 9, of patella and tibia of first leg 12·5.

♀. *Carapace* equal to or slightly less than patella and tibia of first or fourth leg and much less than metatarsus and tarsus of fourth; width of anterior edge of carapace much less than the length of the metatarsus of the fourth leg.

Measurements in mm. Total length 25·5, length of carapace 9·5, of first leg 25, of second leg 22, of third leg 20, of fourth leg 27·5, of patella and tibia of fourth 9·5, of metatarsus of fourth 7·25.

Material. A large number of males and females collected by Mr. S. E. Peal, at Sibsagar, Assam. (Ind. Mus. coll. and Brit. Mus. coll.)

Chilobrachys stridulans, Wood-Mason.

Mygale stridulans, Wood-Mason, *Proc. As. Soc. Bengal*, p. 197 (1875); id., *Tr. Ent. Soc.*, p. 281, pl. vii (1877).

Chilobrachys stridulans, Poc., *Fauna Brit. India* (Arachnida), p. 198 (1900).

Musagetes masoni, Poc., *Ann. Mag. Nat. Hist.* (6), xv, p. 174, pl. x, fig. 6 (1895).

Chilobrachys masoni, Poc., *Fauna Brit. India* (Arachnida), p. 197 (1900).

Material. Two adult males and many females from Sibsagar, Assam (Peal coll.). Three males from Aideo (Peal coll.) and a female from Goalpara, Assam. A male and two females from Punkabaree, Sikhim.

Var. *masoni*, Poc.

Material. A male and a female from Silcuri, Cachar. Five females (the types) from Sylhet, Assam.

Remarks. Both the male and female of *Chilobrachys masoni*, Poc., are very closely allied to *C. stridulans*, Wood-Mason, and only seem to differ in the broader and more conspicuous bands of white at the apices of the tibiæ, patellæ, etc., of the limbs. Whilst these bands of white are clearly visible in the females of *stridulans* from Sibsagar, they are less conspicuous in the males accompanying them. I think that it would be best to regard *C. masoni* as a colour variety of *C. stridulans*.

Chilobrachys (*Neochilobrachys*) *subarmatus*, Thorell.

Ischnocolus subarmatus, Thorell, *Kongl. Sv. Vet. Akad. Handl.*, xxiv, No. 2, p. 13 (1891).

I. inermis (Auss.), Thorell, *Ann. Mus. Civ. Genova*, xxxvii, p. 172 (1897).

Phlogiellus subarmatus, Pocock, *Fauna Brit. India* (Arachnida), p. 202 (1900).

Mandible. Outer surface of mandible furnished with short spinules.

Palp. Anterior surface of coxa of palp with a single row of spiniform bacilli, which vary in number from two to six and have no band of hair above them (fig. 2). In young specimens the bacilli may be absent.

Legs. Tarsal scopulæ of first and second legs entire; tarsi of third and fourth legs with their scopulæ divided by a line of setæ, which is much wider in the case of the fourth leg. Fourth leg with three claws.

Material. A single adult male and numerous females from the Nicobars. (Ind. Mus. coll. and Brit. Mus. coll.)

Remarks. This interesting species is chiefly characterised by the structure of its stridulatory apparatus, the half which is situated on the coxa of the palp being exceptionally simple and elementary in character. I think that it would be best to institute a subgenus of *Chilobrachys* for it, and I propose the name *Neochilobrachys* for this new subgenus.

ANNANDALIELLA, gen. nov.

Carapace. Thoracic fovea straight, transverse. Eyes of anterior row strongly procurved.

Labium broader than long and spinulose apically.

Sternum. Posterior sigilla of small size, widely separated from one another and separated from the margin by about one-and-a-half times their diameter.

Mandibles with their inner surfaces furnished with a stridulatory organ consisting of an oblique row of spines, few in number; the two halves of the organ being exactly similar in structure.

Legs slender. Tibiæ and metatarsi of anterior pairs armed with apical spines alone, below; tibiæ and metatarsi of posterior legs armed with a number of spines.

Spinnerets. Upper spinnerets four-jointed, the apical segment being longer than the penultimate segment.

[1] *Annandaliella travancorica*, sp. nov.

♀. *Colour* (specimen rubbed) pale yellowish brown.

Carapace equal in length to patella and tibia of first or fourth legs, considerably longer than patella and tibia of second and a little shorter than patella, tibia and tarsus of palp. Anterior median eyes further apart from one another than from the elongate anterior laterals, and of smaller size.

Legs. Metatarsus of fourth leg equal in length to patella and tibia of second and almost equal to metatarsus and tarsus of third. Patella and tibia of third leg about equal to patella and tibia of palp.

Metatarsus of first leg scopulate for almost its entire length; metatarsus of fourth only scopulate at the apex. Tarsal scopula of first leg undivided, that of the second faintly divided, and the scopulæ of the tarsi of the third and fourth distinctly divided by a line of setæ.

Tibia of first leg, and metatarsi of first and second, armed below with a single apical spine; tibia of second with three apical spines. Tibia of fourth furnished ventrally with two strong spines and also with a number of apical spines; its anterior side with two spines, and the posterior with four. Metatarsus of fourth leg with 1.1 antero-dorsal spines and with postero-dorsal spines corresponding

[1] The stridulatory organ of this spider is described and figured in *Ann. Mag. Nat. Hist.* (8), ii, p. 402, text-fig. 3 (1908).

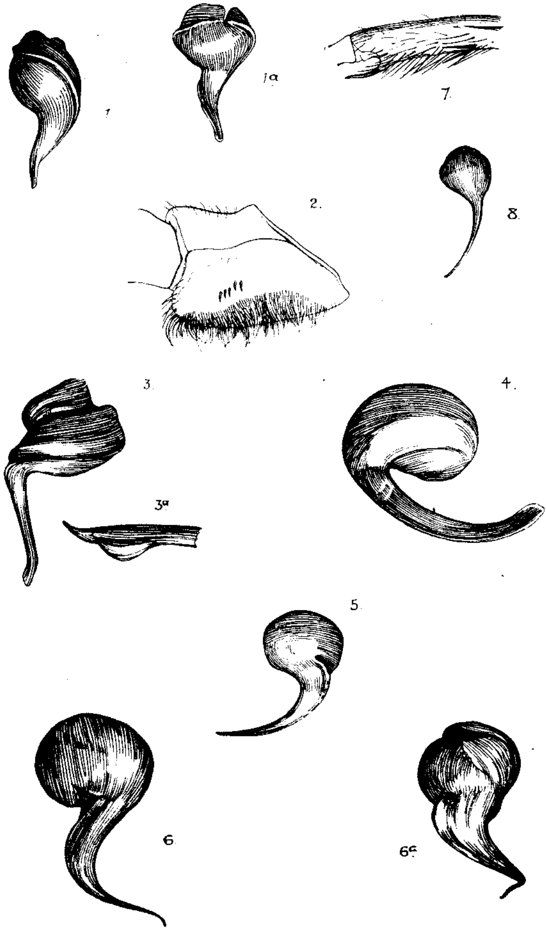
to them in position; its ventral surface armed with two spines and with apical spines besides. Tibia and metatarsus of third leg also spined.

Measurements in mm. Total length 28·5, length of carapace 12·5, of first leg 30·75, of second 26·75, of third 26, of fourth 36·5, of patella, tibia and tarsus of palp 13·25, of patella and tibia of first leg 12·5, of metatarsus of fourth leg 10.

Material. A single adult female from Travancore. (Ind. Mus. coll.)

EXPLANATION OF PLATE XXIV.

FIG. 1.—*Chilobrachys assamensis*, Hirst.
,, 2.— ,, *(Neochilobrachys) subarmatus*, Thor.
,, 3.— ,, *fumosus*, Poc.
,, 4.—*Selenocosmia honesta*, Hirst.
,, 5.— ,, *insulana*, Hirst.
,, 6.— ,, *obscura*, Hirst.
,, 7.—*Damarchus assamensis*, Hirst.
,, 8.— ,, ,, ,,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[*N.B.*—An asterisk (*) preceding a line denotes a new subspecies or variety; a dagger (†) indicates a new species; a section (§), a new sub-genus; and a double-dagger (‡), a new genus: synonyms are indicated by the page numbers being printed in bold-faced type.]

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